SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

Fremont, California

ANNUAL NARRATIVE REPORT

Calendar Year 1987

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEWS AND APPROVALS

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Richard A. Coleman 9/26/88

Refuge Manager Date Refuge Supervisor Review Date

Regional Office Approval Date

INTRODUCTION

San Francisco Bay has long been regarded as a gateway to America. So it is fitting that the San Francisco Bay National Wildlife Refuge (NWR) plays that same role as a "gateway" to the U.S. Fish and Wildlife Service programs and the 430+ units of the National Wildlife Refuge System.

In 1972, Public Law 92-330 provided for the establishment of San Francisco Bay National Wildlife Refuge for the preservation and protection of critical habitat and associated wildlife, migratory waterfowl and to provide an opportunity for wildlife-oriented recreation and nature study. San Francisco Bay National Wildlife Refuge encompasses approximately 19,000 acres in San Mateo, Alameda and Santa Clara counties, California at the southern end of San Francisco Bay. San Francisco Bay is one of the largest estuaries in the nation, approximately 55 miles long and 3 to 12 miles wide.

Under an agreement between the Leslie Salt Company and the Service when the refuge was established, approximately 12,500 acres remain as active salt evaporation ponds. The remaining habitat consists of salt marshes, upland, tidal mudflats and open water.

This variety of habitat supports a large number of wildlife, including 5 endangered species. San Francisco Bay is a key wintering area for diving ducks along the Pacific Flyway; the south bay is used primarily by scaup, surf scoters and ruddy ducks. The south bay wetlands support hundreds of thousands of shorebirds along with the largest wading bird rookery located in the bay.

Marine mammals also utilize the open water and sloughs. A major harbor seal haul out site is located in Mowry Slough.

San Francisco Bay National Wildlife Refuge is surrounded by an urban population of 5 million people. In spite of the potential impacts of encroaching development plans are to complete acquisition of the approved 23,000 acres.

The refuge is a place to learn about the Bay environment through exhibits and naturalist programs; to observe and photograph wildlife; to hike, hunt and fish; and to enjoy some precious open space in the heart of a great metropolitan area.

Included in the San Francisco Bay NWR Complex are eight coastal refuges, stretching from Monterey Bay to the Oregon border. This complex is a unique combination of habitats and wildlife species. The San Francisco Bay NWR in the south Bay has tidal marshes and salt ponds. At the north end of the Bay is the San Pablo Bay NWR with estuarine and upland habitat. The Farallon Island NWR, which lies thirty miles off the coast from the Golden Gate Bridge, is comprised of high rocky islands frequented by a host of seabirds and seals. A quiet upland habitat for the endangered Santa Cruz long-toed salamander can be found at the Ellicott Slough NWR just south of Santa Cruz. The Salinas River Wildlife Management Area just north of Monterey encompasses an area of pristine beach, dunes and lagoon habitat. Found in the small pockets of native habitat at Antioch Dunes NWR are the Antioch Dunes Evening Primrose, Contra Costa Wallflower and the Langes Metalmark Butterfly. North of the Bay Area are the estuarine and tidal flats of Humbolt Bay NWR. Finally, the off-shore island, Castle Roack NWR offers a home for the endangered Aleutian Canada Goose, seabirds and seals.

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A. HIGHLIGHTS

250 acres were restored to tidal marsh by developers and then donated to the refuge (Section C. 3).

Volunteers donated 13,200 hours of service, a 19% increase over 1985 (Section E. 4).

Asbestos laden soil near the Environmental Education Center was covered by clean soil and a plastic polymer using EPA Superfund (Section E. 6).

Over 250,000 people visited the Refuge in 1986. Many special events drew large crowds (Section H. 7).

B. CLIMATIC CONDITIONS

In a normal year, the Bay Area has a modified Mediterranean climate with warm to hot, dry summers and moist, mild winters. Ninety percent of our rainfall occurs in the late fall and winter months with January being the wettest. Normal annual rainfall amounts vary according to local topography. In the South Bay 16-20 inches is normal while some areas in the North Bay receive more than 45 inches.

The fall and winter of 1987 had below normal rainfall with November and December being very cold. The summer was very warm in comparison to past years.

C. LAND ACQUISITIONS

1. Fee Title

Several more small tracts (1/8-1/4 acre) were purchased within the Alviso and Mowry Units during the year. We still have a number of sites remaining to be purchased at "Drawbridge" and in the "New Chicago Marsh" area of the Alviso Unit. The ability of our realty people to locate missing owners and the availability of funds will determine the length of time required to complete these purchases.

3. Other

Approximately 1,000 acres of tideland parcels in Alameda, Santa Clara and San Mateo were added to our existing lease with the California State Lands Commission. This action will increase management possibilities and afford the additional protection of refuge status to these resources.

D. PLANNING

2. Management Plan

Parts I and II of the Refuge Management Plans for Antioch Dunes, Humbolt Bay, San Francisco Bay and San Pablo Bay NWRs were in various stages of development at the end of the year.

4. Compliance with Environmental Mandates

Refuge staff negotiated with the City of San Jose regarding their after-the-fact Section 10 permit request to allow the placement of culverts on the refuge at Artesian Slough. These culverts were illegally installed during the flood of 1983. The Corps of Engineers refused to grant the permit until FWS requests were met. We requested that two of the culverts be made functional with screw flapgates to permit management of water levels and that the asbestos-laden fill that was used by the City to install the culverts be removed. The polymer cap that was applied over the asbestos fill in 1986 did not prove to be an effective long-term solution to this health hazard, since it had begun to deteriorate by mid-1987. Work had not yet begun by the end of the year.

5. Research and Investigations

Soil/plant correlation in San Francisco Bay tidal marshes: In June, Dumbarton Marsh and Tract 102 in the headquarters area were studied by Anni Eicher as part of a FWS contract study. Her objectives were to determine the relationship between wetland plants and hydric soils, and investigate their relationship to the hydrology of tidal marshes and diked wetlands, among other habitats. Methods included identification of soils, plant species composition, and relative cover determination within sample plots. The final report will be available in 1988.

San Francisco Bay contaminant monitoring study: The refuge received $98,000 in FY 87 to conduct a contaminant monitoring study on four of the refuges in the complex. (Studies are described here rather than under individual refuges.) Funds were received as a result of the Threats and Conflicts identification process conducted in the mid-1980's. Potential threats identified included agricultural runoff at Salinas River and in San Francisco and San Pablo Bays, landfill leachate runoff at Humboldt Bay, and industrial and residential effluents in San Francisco Bay habitats. Our objectives were to identify contaminants and levels of concern for refuge wildlife. During the summer, refuge staff collected over 80 samples including fish, invertebrates (bivalves), duck and California clapper rail eggs, and sediments from Humboldt, Salinas, San Pablo Bay and/or San Francisco Bay NWRs. In addition, 101 canvasback and scaup collected by the California Department of Fish and Game were shared with the refuge, so that these birds could be analyzed for metal and organochlorine levels, as well as selenium. We also submitted 36 least tern eggs collected by the Research Division

for organochlorine and metal analyses. All samples except for the sediments had been submitted for analyses by the end of the year.

Sampling for the contaminant monitoring study included the collection of mussels on the mudflats at Humboldt Bay NWR.

Distribution and abundance of waterfowl in San Francisco Bay: We began a cooperative study with the Northern Prairie Field Research Station - Dixon in October 1987. Our role was to conduct monthly aerial waterfowl surveys of the entire Bay and refine methodology in preparation for more intensive surveying (twice every month) to be conducted in 1988-90. Louise Accurso coordinated the survey effort, and in fall 1988, she will work on this project for her Master's thesis as a coop student. Little is known about seasonal change and distribution of waterfowl in the Bay estuary. This study will provide us with a foundation of knowledge, essential for improving management of waterfowl habitat. Results of the 1987-88 season will be reported in 1988 (see G.3).

California gull chick diet in south San Francisco Bay: Master's student Jan Dierks began her thesis study on chick diet of California gulls nesting at the Knapp Property west of Alviso. Methods included collections of chick regurgitations and observations from a blind at various times of day throughout the breeding season. Her field work will continue into 1988.

E. ADMINISTRATION

1. Personnel

PERSONNEL

1. Rick Coleman - Project Leader; GM-13, PFT
2. Ben Crabb - Assistant Project Leader; GS-12, PFT
3. Dick Munoz - Assistant Refuge Manager; GS-11, PFT
4. Sharon Larson - Refuge Assistant; GS-6, PFT
5. Charlotte Cox - Refuge Assistant; GS-5, PFT
6. Joan Dawson - Clerk-typist; GS-4, PFT
7. Stephanie Tolliver - Clerk-typist; GS-4, PFT
8. Olive V. Carter - Clerk-typist; GS-4, PFT
9. Jean Takekawa - Wildlife Biologist; GS-11, PFT
10. Tom Harvey - Wildlife Biologist; GS-7, PFT
11. Louise Accurso - Biological Technician; GS-5, TFT
12. Donna Stanek - Outdoor Recreation Planner; GS-11, PFT
13. John Steiner - Park Ranger; GS-9, PFT
14. Marilynn Friley - Park Ranger; (Vol Cor-ord); GS-7, PFT
15. Steve Farone - Park Ranger; GS-5, TFT
16. Linda Drey - Park Ranger; (Interpretation); GS-7, PFT
17. Kim Dreyfuss - Park Ranger; GS-5, TFT
18. Debby Johnston - Environmental Ed. Specialist; GS-9, PFT
19. Francis McTamaney - Environmental Ed. Specialist; GS-5, TFT
20. Jim Ferrier - Police Officer; GS-7, PFT
21. Jon Adamson - Police Officer; GS-7, PFT
22. Bob Bolenbaugh - Police Officer; GS-7, PFT
23. Barry Tarbet - Police Officer; GS-6, PFT
24. Steve Lewis - Maintenance Worker; WG-4, PFT
25. Mike Bitsko - Maintenance Worker; WG-8, PFT
26. Eric Nelson - Bio Technician (Humboldt Bay NWR); GS-5 TPT

l. to r.: Charlotte Cox, Joan Dawson, Dick Munoz, Ben Crabb, Rick Coleman

l. to r.: Barry Tarbet, Jon Adamson

l. to r.: Bob Bolenbaugh, Jim Ferrier

l. to r.: Tom Harvey, Jean Takekawa, Louise Accurso,

l. to r.: Back row - Donna Stanek, John Steiner, Debby Johnson
Fran McTamaney
Front row - Kim Dreyfuss, Linda Drey

l. to r.: Mike Bitsko, Steve Lewis

The following personnel changes/actions occured during 1987:

Name	Position/Grade	Action
Stephanie Tolliver	Clerk Typist GS-0322-04	E.O.D.06-07-87
Olive V. Carter	Clerk Typist GS-0322-04	E.O.D.08-16-87
Sharon Larson	Refuge Assistant GS-0303-06	Resigned 02-14-87
Charlotte Cox	Refuge Assistant GS-0303-05	Promotion 02-15-87
Steve Lewis	Maintenance Worker WG-4749-07	Promotion 05-24-87
Tom Harvey	Wildlife Biologist GS-486-09	Transfer Out 10-24-87
Dick Munoz	Assistant Refuge Manager GS-0485-11	E.O.D. 02-01-87
Kim Dreyfuss	Park Ranger GS-0025-05	E.O.D. 09-20-87
Steven Farone	Park Ranger GS-0025-05	E.O.D.06-07-87 Resigned 08-29-87
Marilyn Friley	Park Ranger GS-0025-07	LWOP 09-13-87

	Permanent		Temporary			
FY	Full Time	Part Time	Full Time	Part Time	CS	Intermittent
86	19		1	1(HBNWR)		
85	19		1	1(HBNWR)		
84	19			1(HBNWR)		
83	12	3		3	1	1
82	11	1		7	2	1

2. Youth Program

A. Youth Conservation Corp (YCC)

The San Francisco Bay NWR Complex YCC Program consisted of two crews. The program began on June 22, 1987 and concluded on August 14, 1987. At the last minute we received additional funding, allowing us to hire two crew leaders who reported on Monday, June 22, 1987.

Crew members were actively recruited from the eight high schools located in the Tri-City area. Response was not overwhelming, and several of last years crew were hired to fill out the two crews. As in the past, selection of crew members was made by random draw. Jobs which pay above the minimum wage, without the hard work, are readily available in this area, making recruitment more difficult.

We lost one of our crew leaders after two weeks. He was able to land a job paying $10.00 per hour without responsibility of being a supervisor. Maintenance staff assumed the role of crew leader for the remainder of the program.

All of our major projects were completed. Crews were rotated on jobs, in order to expose crew members to a variety of tools and activities.

One crew was outstanding, both in quanity and quality of work completed. The second crew required constant supervision and guidance in order to perform at a satisfactory level.

Safety awareness was discussed on a daily basis with the crews. Safety hazards associated with the days activities were highlighted. Unfortunately, we still had two minor injuries during the program.

One enrollee left the program, but was replaced a day later. While we had no grounds to dismiss any crew members, we were constantly challenged by one crew.

Proposed work projects were completed on time and the overall quality of the work was excellent.

While the program provides a paying job where team-work and mutual respect are learned or taught, it is becoming more difficult to fund the program from the station budget. Recruitment of enrollees in this area of high wages is also becoming more difficult, as is the local recruitment of crew leaders.

Enrollees spent a total of 3,808 hours working and/or participating in the following projects/activities.

Project Code	Project/Activity	Enrollee Hours
310	Recreation Project	240
330	Picnic Fac - Const. Maint	256
360	Observation Site Clean-up	71
370	Litter Pick-up	192
380	Fencing Const/Maint	496
410	VC Maint. (Painting)	876
750	Trail Maint/Boardwalk	1152
810	Ditch Construction	45
950	Field trip/Training	480

B. Eagle Scout Projects-BSA

There were three Eagle Scout projects completed on the refuge this year by local Boy Scouts. A recycling bin for the headquarters/visitor center was built by a scout from Fremont. It will be used primarily in our environmental education program to teach about the recycling process. The second project was part of an overall rehabilitation project of turning a pumphouse into classroom facility. A scout took on the project of building some benches to use at the work stations. The final project was the construction of a 10' x 12' observation platform adjacent to the boardwalk in New Chicago Marsh. This will be used by the general public and as part of the environmental education program at the Environmental education Center.

4. Volunteer Program

The San Francisco Bay NWR volunteer program continued to be very successful during 1987, with both the Service and the individual volunteers benefiting during the course of the year. Volunteers donated approximately 14,000 hours of service. This is 6% increase over 1986. It should be noted that this figure includes hours donated by interns through the Student Conservation Association (S.C.A.). The refuge was able to fill 11 S.C.A. positions in 1987, the same as in 1986. S.C.A. interns contributed 5,085 hours this year.

The non-S.C.A. volunteers saved the government more the $62,000 in wages alone (based on the salary of a GS-5 employee) and contributed the equivalent of 4.2 staff years in time!

The number of active volunteers varied from 38 to 53 during the year, with a total number of 88 individuals contributing time. At the close of the year, there were 60 active volunteers. Though volunteers are requested to donate at least 16 hours per month, individuals actually donated from 4 to 80 hours per month.

Volunteers became involved in a variety of tasks and projects, ranging from interpretation, to biological research, to maintenance work. Approximately 77% of volunteer time was spent in the interpretive and environmental education divisions with the remaining 23% spent in the resource management or maintenance divisions. Volunteers were involved in the following:

Interpretation. Volunteers staffed the information desk and book sales area, and accounted for 98% of the fixed duty hours in the Visitor Center. Due to this valuable donation of time and effort by our volunteers, we are able to keep the Visitor Center open to the public 7 days a week. Volunteers patrolled refuge trails and spoke with hikers, birders, fishermen and joggers that they encountered. During these patrols they took visitor censuses for our public use reports, made note of any needed maintenance, picked up litter and watched for signs of vandalism.

Volunteer Marg Herzog assist a refuge visitor.

Volunteers led and assisted in the presentation of numerous tours and talks throughout the year. Volunteers were largely (99%) responsible for a popular van tour of the abandoned ghost town of Drawbridge and tours of satelite refuges. We occasionally presented an evening astronomy program for Refuge visitors, thanks to the efforts of two of our stargazing volunteers. Without our Refuge volunteers, many special programs such as "Kids Day", "Open Houses" "National Wildlife Week" and "Annual Wildlife Art Show" would not have been possible. They also staff booths at various information community and environmental fairs. Without their efforts many people would not know about the refuge or the Service.

Volunteer Mansur Nurmuhammad discuss the facts of nature with a young visitor. Volunteers conduct many of our outdoor nature programs.

Volunteers contribute both baked goods and their time at the Annual Wildlife Art Show.

Resource Management. Volunteers lent a helping hand for surveys and censuses such as the Aleutian Canada Goose and murre projects. In addition, a number of work parties occurred throughout the year at two of our satellite refuges. A number of volunteers helped with exotic species removal (plants) and revegetation at Antioch Dunes NWR. During Coast Day, a large group of volunteers helped remove lots of garbage from the Shoreline Trail.

Student Conservation Association Interns. During the course of 1987, eleven full-time 12-week appointments were filled with volunteers through the Student Conservation Association. In exchange for their full time volunteer services the refuge provided them with housing and a small subsistence of $50.00 a week.

Due to funding problems on S.C.A.'s end at the end of the year, the winter positions went unfilled. The SCA interns are an invaluable asset to the refuge program. They have provided us with professional quality work and it is always enjoyable to work with them.

One advantage to the location of an urban wildlife refuge is that there is large population base located nearby that serves as a vast reservoir of potential volunteer candidates. The Refuge is

able to have a successful program, because there are normally adequate numbers of interested people on our waiting list to replace those volunteers who drop out of the program. We recruit new people through local public service announcements, attending and hosting community service club meetings, displays at various off site information fairs in which the refuge participates, word-of-mouth advertising, and articles in the quarterly Tideline newsletter. An application/brochure which describes the volunteer program is available in the Visitor Center, and is given to those prospective volunteers who see it and ask for it.

All volunteers go through an refuge orientation here Manager Rick Coleman instructs on FWS organization.

In April refuge volunteers were recognized for their efforts at the 5th Annual Awards Banquet. The refuge splurged and had another steak feed (with funding coming from Coastal Parks Association). A great time was had by all! All the volunteers received Certificates of Appreciation. Seven outstanding volunteers, who donated the most time throughout the year received special recognition. This was the second year the refuge gave a "Volunteer of the Year Award". Virginia Valentine received the award this year.

The refuge recognizes volunteers through a Volunteer of the Month Award. This award was developed to recognize volunteers who have made special contributions to the refuge but who have not necessarily logged lots of hours.

VOLUNTEERS OF THE MONTH
January - December 1987

Tim Segale — Mansur Nurmuhammad
Janice Shapiro — Sue Macias
Jack Runyan — Monty Dewey
Helen & Stan Kalick — Marsh-In Leaders
Marg Herzog — Stan Brown
Ken Crowley — Jackie Freeburg

The success of the volunteer program is due to the dedication and talents of the volunteers themselves. Their efforts are sincerely appreciated by the Refuge as well as the Fish and Wildlife Service.

5. Funding

All units in the Complex, were funded this year as the San Francisco Bay National Wildlife Refuge Complex. The operating budget (O&M) for FY '88 is:

	1260	1113	1262-YC	1975	7201	TOTAL
O&M -	(592.6)					
Sm. ARMM -	(142.2)					
RPRP Contammates	(98.0)					
Other RPRP	(58.0)					
Lg. ARMM -	(204.0)					
Total	1031.8	10.0	25.5	35.0	8.00	1110.3

Operating cost budgets for FY '81 through FY '86 are shown below:

FY	1210(MB)	1220(MNB)	1230(ADC)	1240(I&R)	1400(SE)
86	957.4				10.0
85	717.4				15.0
84	805.0				15.0
83	245.9	31.0	.5	258.5	36.0

6. Safety

a. Safety Programs

Safety programs presented during the year included the following:

--Accident prevention
--Defensive driving
--Films on water safety
--Aircraft safety
--Chainsaw operation

b. Accidents

1987's safety record showed a continuation of the trend toward improvement on the refuge.

We had five accidents involving falls by visitors, staff, and volunteers. One fall resulted in stitches being taken in the leg of an LE Officer responding to the scene of a fire at a railroad construction site in the ghost town of Drawbridge. One other fall, on the Visitor Center observation platform, resulted in a broken arm.

The cargo boom cable on the Farallon Islands slipped with a load on it. During a subsequent test with a one ton weight the cable failed and the weight fell into the ocean. The cable was replaced and the weight was recovered.

We had two known bike accidents with cuts and brusies. One occurred when the rider choose to enter a closed area and did not see the barbed wire fence until after he hit it. The other involved a juvenile that was traveling to fast to maintain control when she tried to turn. She had appartently been involved in an earlier accident that day as she had fresh clean bandages on her elbow. Her scrapes were cleaned and bandaged.

The YCC crews were involved in two accidents with hammers resulting in minor injuries.

There were also five vehicle accidents involving staff, volunteers, or SCA's. No injuries were reported in any of these accidents. Approximately 12 accidents occurred on State Route 84 which runs through the refuge and parralel to Marshlands road, vehicles and or debris ended up on Marshlands Road or in salt pond as a result of these accidents. All accidents were handled by the California Highway Patrol. The fence separating SR 84 and Marshlands Road was damaged in each of the accidents, sometimes blocking the bicycle path. Caltrans (CA highway Department) was very prompt with repairs, usually clearing the hazard within 24 hours and repairing the fence within two weeks.

c. Safety Committee

The safety committee consists of a representative from the following units on the refuge complex: Public Safety I&R Program, Environmental Education Center, Biologists, Administration and Maintenance (chairperson).

d. Safety Committee Actions

The committee reviewed all accidents that occurred on the complex and made recommendations and suggestions as needed.

e. Inspections - Non Refuge Personnel

Fremont Fire Department made quarterly inspections of the Headquarters-Visitor Center. The fire hydrant was checked for flow and all extinguishers were inspected and serviced as needed.

The San Jose Fire Department inspected the Environmental Education Center and the Alviso Central Site at least twice during 1987.

8. Other Items

San Francisco Bay Brands which harvests brine shrimp on refuge salt ponds paid the Service $103,376.00 during 1987. The contract expired in June 1985, but harvesting has continued under a Special Use Permit until September 30, 1987.

Leslie Salt Company utilizes the ponds on the Knapp Tract, Alviso Unit, as a part of their production cycle. The annual fee to the Service for the use of this 452 acre tract is $3,500.00.

The three pay phones located on the refuge continue to generate approximately $70.00 - $75.00 per year.

Revenue sharing payments totaling $35,554.00 were payed as follows: Alameda County $22,304.00; Santa Clara County $9,928.00; and San Mateo County $3,322.00. This represents 60% of the total.

F. HABITAT MANAGEMENT

2. Wetlands

Progress was made on the scaled-down proposal for enhancement of the 150 acres of abandoned salt crystallizing ponds (Tract 102) opposite the refuge headquarters/visitor center. The Engineering Division in the Regional Office developed a design and permit package based on our proposal, which consisted of some dredging, dike work and installation of water control structures and a

windmill. Management at this site through retention of tidal waters and freshwater runoff will provide foraging areas for wintering shorebirds and waterfowl during all tidal conditions. During the summer, the dried salt pond surfaces will provide nesting substrate for snowy plovers. An adult plover with two chicks was seen there in May 1987. In the meantime, two wooden flap gates effectively held bay water in two pond units during winter flood tides. These ponds were regularly used by hundreds of avocets and black-necked stilts during the winter. Shorebird use peaked at over 20,000, predominantly western sanpipers. Biological staff and volunteers with the Student Conservation Association, conducted a wildlife and water monitoring program on Tract 102 to assess the effects of habitat management efforts.

A draft plan was developed for the proposed enhancement of New Chicago March, adjacent to our Environmental Education Center in Alviso. This area, which historically supported tidal marshland, became isolated from the bay by the construction of the salt evaporation ponds during the 1920's. Introduction of bay water would improve water circulation and enhance the site for both wintering and breeding waterbirds. Funding for this enhancement will originate from fines which were levied against the City of San Jose for a series of sewage upsets at their Santa Clara Pollution Control Plant in 1979 and 1980. Peninsula Open Space Trust is responsible for disbursement of these funds, which may also go toward construction of a colonial bird observation tower near the EEC.

Refuge staff continued to manage five abandoned salt evaporation ponds south of Highway 84 west of the headquarters/visitor center. By leaving a tide gate continually open, tidal access was restored to the first four ponds in the series. A wooden flap gate was installed at the entrance of the fifth pond allowing tidal waters to be held back and maintained at depths suitable for waterfowl, such as shoveler, ruddy duck and scaup. It was then drained in the spring to provide nesting habitat for snowy plovers. A peak of 14 plovers and at least two nests were observed in 1987.

In 1986 the refuge acquired a 250 acre parcel of historic bay marshland, which was restored to tidal action as mitigation for construction of an approximately 400 acre industrial park in Fremont. Restoration of the area increased the volume of tidal water moving through the sloughs and creeks which enter the southern arm of San Francisco Bay. This will in turn facilitate scouring and erosion of these channels, many which have become clogged by depositing silts and clays. The majority of the property consists of a large tidal pond, which by late fall supported several hundred ducks including scaup, canvasback, pintail, mallards, wigeon, and cinnamon teal, and an occasional harbor seal. It was also a roost site for over 1,000 California gulls. In addition, the parcel included a 40 acre diked pickle-weed marsh, to be managed for the endangered salt marsh harvest mouse. Two screwgates make it possible to introduce tidal water.

However, when the property was flooded in the spring to improve vigor of the pickelweed, a mosquito outbreak resulted. It became necessary to drain the property and the local mosquito abatement district sprayed it with a biological control agent. A management plan will be developed for this property in 1988.

On July 22, a 200 gallon diesel spill occurred in the branch of Coyote Creek that feeds the King and Lyons tidal pond. An IBM generator had leaked diesel into an adjacent storm water system. The spill was not reported until a very high and low tide had flushed the diesel through the creek. Booms and other absorbent materials were used to recover as much diesel as possible. Refuge staff assisted the Coast Guard with a damage assessment. A small number of nesting California clapper rails may have been impacted as well as other nesting waterfowl and water birds. Fortunately, this more refined compound was expected to break down relatively rapidly.

A 200 gallon diesel spill flushed into this branch of Coyote Creek. Diesel was recovered with booms, however, much had already washed through the slough on high and low tides before booms were put in place.

6. Other Habitats

The Refuge contains approximately 9000 acres of solar salt evaporation ponds operated by the Leslie Salt Company. Unfortunately, when the Service gained ownership of the ponds, we did not obtain management rights to the area. Since Leslie may continue to harvest salt in the ponds in perpetuity, the refuge has little input in management of the ponds. In the eventuality that Leslie may someday cease salt making operations, all management rights revert to the Service. Therefore, we have been conducting monitoring studies of the salt ponds to understand the biological processes of this unique habitat.

In tidal intake ponds and early series salt ponds, the water remains fairly clear,with salinities ranging from that of the bay waters to double the normal salinity. In these ponds wigeon grass grows profusely, attracting large numbers of waterfowl, including shoveler, pintail, gadwall, and canvasback. Fish can also survive in these ponds and some species reproduce there. The common species are long-jawed mudsucker, three-spined stickleback, staghorn sculpin, topsmelt and others. These fish attract thousands of fish-eating birds, such as white and brown pelicans, double-crested cormorants, terns, herons and egrets.

As salinities increase in the solar salt pond series, algae and halophytic bacterial blooms occur, turning the water into various shades of brown, green, orange, pink and red. The algae are fed upon by brine shrimp (Artemia) which then undergo mass population blooms. Brine shrimp and brine shrimp eggs are harvested commercially on Refuge salt ponds via a contract inherited by the Service from the previous owner. During 1984, this contract expired and a temporary extension was given. In 1987, a contract was awarded to a new contractor, the Novalet Company. For the first time, the harvest of brine shrimp eggs (actually more lucrative than the sale of shrimp) was included in the contract, to insure that the federal government would receive revenues for this additional harvest. Also for the first time, two ponds were withheld from harvest to make it possible to investigate the potential impacts that harvesting has on brine shrimp populations. The new company is more research oriented, and plans to do studies to learn more about brine shrimp biology and population dynamics. Meanwhile, the former contractor, Bay Brands has threatened to bring suit against the Fish and Wildlife Service. They continue to harvest shrimp in adjacent salt ponds in the South Bay, under contract with the Leslie Salt Company. The new harvesting agreement should provide increased revenue and greater control over the harvest to the benefit of wildlife.

Brine shrimp and invertebrates such as brine flies and water boatmen are extremely important to many migratory birds using the salt ponds. Scaup, ruddy duck and bufflehead utilize this food source heavily along with thousands of eared grebes, phalaropes, California gulls, black-necked stilts, American avocets and other sandpipers and plovers. Our long range goals are to gain complete management control of the salt ponds and boost

production of fish and invertebrates in the appropriate salt ponds for the benefit of migratory bird populations as well as commercial harvest if compatible. Those salt ponds of low biological value will be restored to tidal marsh.

G. WILDLIFE

2. Endangered and/or Threatened Species

a. California Brown Pelican

As in previous years, brown pelican use of south San Francisco Bay continued at a relatively low level compared to other areas on the central California Coast. Major use areas for this species include central San Francisco Bay, the Farallon Islands and Monterey Bay. Approximately 150-200 pelicans normally inhabited the salt ponds and open bay, both on Refuge lands and on adjacent property. High use areas were low salinity (30-45 ppt) salt ponds where birds frequently display a rather atypical surface feeding behavior. Pond levees also provided roosting sites for this species. Brown pelican die-offs were reported in late 1987 in Monterey Bay, but none were observed in San Francisco Bay.

b. American Peregrine Falcon

This species may be encountered year-round in south San Francisco Bay, however, most records occur during late fall and winter. The abundant shorebird and waterfowl populations utilizing San Francisco Bay during the winter and migrational periods provide a readily available prey base for this avian predator. Peregrines were occasionally sighted in the vicinity of the headquarters and Dumbarton Bridge. In early fall, a peak of three was seen near the railroad bridge, south of the Dumbarton Bridge. On November 5, an immature peregrine was found dead on the Baumberg property adjacent to the refuge. It may have struck a powerline.

c. California Least Tern

Management efforts for this species consist of improving the habitat and monitoring breeding effort at the primary South Bay colony. This colony, which was historically located on the dried surface of an abandoned salt pond near Redwood City, has not supported successful nesting for the past two years. Reasons for abandonment are not clear, but may be due primarily to encroachment by vegetation (Salicornia) into the site and/or because Caspian Terns, which provide protection from raptor predation, also abandoned the site two years ago. Monitoring was conducted by volunteers with the San Francisco Bay Bird Observatory. The California Department of Fish and Game (CDFG), which owns the property, has expended considerable efforts in protecting the site from tidal inundation and attempting to make it more attractive to terns. During 1987, they finished rehabilitation of levees surrounding the site, moved oyster shell onto the

levees to provide suitable nesting substrate, and built a nesting platform of shell. Caspian terns recolonized the site in 1987, peaking at 800 birds, but an unknown number of nests.

d. California Clapper Rail

A new 15' Panther airboat was purchased and used to conduct winter censuses of clapper rails. Surveys were conducted in extreme high tides (9.0 feet above mean lower low water) when cover is minimal and birds are easily counted. A survey of Mowry Slough marsh produced a total of approximately 80 rails, a 50% decrease from surveys conducted in the late 1970's and early 1980's. A cooperative survey by Service and CDFG staff indicated that fewer rails now inhabit the southernmost end of the bay, probably because tidal marshes have been heavily influenced by fresh water sewage effluents and no longer support the pickleweed/cordgrass community typically inhabited by rails. An updated population estimate was developed in 1987 based on airboat surveys conducted in the early 1980's. Total numbers may range around 1,000 birds, much lower than previous estimates of 4,000-6,000. Most of the population occurs in the South Bay. Habitat losses there due to fresh water influence create further stresses on an already reduced population. More surveys will be conducted in 1988 to update the status of rails in specific South Bay marshes.

Surveys indicated a 50% decline in California clapper rails since the early 1980's in Mowry slough marshes. The biggest harbor seal pupping site in San Francisco Bay also occurs here at Mowry Slough.

Predation was a growing concern as sightings of non-native red foxes increased tremendously in the South Bay (G.15). However, observations of other predators (rats) in Dumbarton Marsh revealed that numbers were much lower in 1987. Approximately 30 were seen in 1986 in a single survey (half were eliminated), but only two were seen and killed there in 1987.

Resightings of individually-color banded California clapper rails also continued as part of a joint refuge/San Francisco Bay Bird Observatory project. Resightings or recaptures of banded individuals have revealed a high degree of territorial site fidelity within the south San Francisco Bay rail population. For example, of 50 individuals which have been resighted at least once, 32 (64%) were observed 100 meters or less and 13 (26%) were observed 100-500 meters from their original capture sites. Four individuals have been recorded moving distances of 1 kilometer or more between different salt marsh parcels. One of these was resighted 10.5 kilometers from it's initial capture location. In November, three were resighted in Dumbarton Marsh, including two that were banded there in 1985 and one in 1983.

In 1986, 24 California clapper rail eggs were collected for selenium, mercury, and organochlorine residue analyses. They were collected from tidal marshes on and off the refuge, in both the North and South Bay. Preliminary results from the 1986 samples indicated that organochlorine levels were relatively low. However, selenium levels were higher in certain North Bay sites adjacent to refineries than in South Bay sites. To increase the small sample size in these sites (from two), six more eggs were collected there in 1987. In addition, eight clapper rail eggs were collected for us in North Carolina to provide a comparison with a relatively clean site. We expect to receive laboratory results in 1988.

California clapper rail nests are extremely well hidden in the marsh. A sample of eggs was collected as part of the contaminant monitoring study.

e. Salt Marsh Harvest Mouse

New Chicago Marsh continued to support a significant mouse population in its western end. Management responsibilities increased this year with the acquisition of the King and Lyons property, which includes a 40 acre pickleweed parcel to be managed for the mouse (F.2). In addition, we became responsible for managing a section of Pacific Railroad right-of-way that was enhanced as part of mitigation for the construction of a railroad bridge. This pickleweed habitat and water control structure will be managed by the refuge for the salt marsh harvest mouse.

f. Aleutian Canada Goose

We continued to monitor the Aleutian Canada geese that overwinter around the East Bay reservoir system, mostly through a volunteer effort. Numbers peaked at 98 in early January at the Nunes ranch stock pond compared to 139 in 1985-86. Eighteen color banded birds were identified. Rocket netting was not attempted because geese left early (mid-January). Extremely dry conditions resulted in poor food conditions. In 1987-88, geese were very late to arrive, probably because of the continued drought conditions and poor food. By late December, numbers had peaked at 77 including 14 color banded birds.

3. Waterfowl

More intensive monthly waterfowl surveys were conducted in 1986-87 (December through March) and expanded in the fall of 1987 (October through March). Aerial surveys were conducted over all of the open water of San Francisco Bay, as well as the salt ponds and other wetlands which fringe the Bay. By late 1987, each survey took 12 hours of flight time over two days to complete. During the 1986-87 season, waterfowl numbers peaked at over 300,000 in December, including over 40,000 pintail. Species in greatest abundance included scaup, scoter, pintail, shoveler, ruddy, canvasback, and wigeon, in decreasing order of abundance. Surveys confirmed that most puddle ducks occurred in the salt ponds, but that large numbers of canvasback and ruddy duck also used the ponds. Scaup and scoter numbers increased late in the season (February and March) in the central part of the open bay, which may indicate that some are using the bay as a staging area.

Canvasback were typically found concentrated in rafts along the edges of the open bay at the mouths of creeks and sloughs, and in the lower salinity salt ponds (note shadow of survey plane).

In October 1987, we began a cooperative study with Northern Prairie Field Research Station - Dixon, on the distribution and abundance of waterfowl in San Francisco Bay (D.5). Over 80,000 scaup were surveyed in San Pablo Bay in October, but numbers subsequently dropped through the fall. Some of these birds may have been using San Pablo Bay as a staging area before moving further south for the winter period. Total numbers in December were lower than in 1986, peaking at just over 200,000.

During the 1986-87 season, CDFG biologists collected scaup and canvasback from four regions of the Bay for selenium analyses. Their results indicated that selenium residues were higher in scaup than in canvasback. Both selenium and mercury levels were higher in San Francisco Bay than in reference sites near Humboldt Bay.

In April, Louise Accurso spent three weeks participating in annual waterfowl breeding surveys in North Dakota and Montana.

4. Marsh and Water Birds

The Refuge currently supports two active breeding colonies of herons and egrets. The colony on Bair Island, San Mateo County, was established in 1967 when great blue herons first colonized the area. Two years later, black-crowned night herons and snowy egrets initiated breeding activities on the island and the number of breeding pairs began to increase rapidly. The other colony was formed in 1976 when black-crowned night-herons and snowy egrets began nesting in Mallard Slough, Santa Clara County near the Environmental Education Center. At this site, nests are found in dense stands of hardstem bulrush which has become established in response to tremendous outflows of treated sewage effluent (freshwater) from the San Jose/Santa Clara Water Pollution Control Plant. In 1987, Mallard Slough heron rookery had lower numbers of black-crowned night herons (42 compared to 190) and higher numbers of great egrets (50 compared to 8) than in 1986. Two pairs each of cattle egrets and little blue herons and 280 snowy egrets also were surveyed.

Herons and egrets nest in hardstem bullrush in the Mallard Slough rookery. In 1987 snowy egret numbers were similar to 1986 numbers, but black-crowned night heron numbers declined. The Bair Island colony is located on the bayward side of an island near Redwood City where old dredge spoils support a stand of coyote brush, thistles and annual grasses. Due to old age, extensive use by nesting herons, and lack of recruitment of new plants, the coyote brush stands on Bair Island are deteriorating. In response to this and nest site competition, egrets and herons have begun nesting on the ground and among thistles where they are more susceptible to disturbance and predation. In addition, a 70% decline in the nesting population of great blue herons at Bair Island over the past 15 years may be related to the progressive degeneration of the coyote brush.

In an effort to determine if a shortage of suitable nesting bushes is limiting the size of the nesting heron population, eight nesting platforms were erected in the vicinity of existing nest sites by YCC crew members in 1986. Though the platforms were used for roosting, they were not used by nesting herons in 1987. In 1987, the rookery consisted of 139 Snowy Egret nests, 243 Black-crowned night heron nests, 15 Great Blue Heron nests, and 2 Great Egret nests.

5. Shorebirds, Gulls, Terns and Allied Species

Forster's and Caspian Terns have nested in south San Francisco Bay since 1948 and 1916, respectively. Prior to the conversion of the majority of tidal marshes around the bay into salt

game farms. Active dens were suspected at sites adjacent to the refuge at Coyote Hills Regional Park and the Baumberg Tract. These effective predators have caused tremendous losses of least terns and clapper rails in southern California. They are very adapt at hunting in inundated marshes. However, fox control has been an extremely controversial issue in California. Refuge staff initiated passage of a resolution by the American Ornithologists' Union supporting control of red fox in San Francisco Bay. We also worked with CDFG toward developing a coordinated control effort.

16. Marking and Banding

This year marked the fifth year of color-banding young from the major south bay California Gull colony. A total of 2,500 gull chicks was banded with USFWS bands by bird observatory volunteers.

Members of the bird observatory conducted land bird banding demonstrations near the refuge headquarters, the Environmental Education Center and at their headquarters in the Alviso Cannery building.

H. PUBLIC USE

1. General

San Francisco Bay National Wildlife Refuge serves a dense, local population of more than 7 million people. It provides a perfect opportunity for bay area urbanites to visit a relatively unspoiled area, enjoy the local wildlife and learn about nature, conservation and wildlife management.

During 1987, over 300,000 people visited the refuge; more than any previous year. Of these, over 9,100 teachers went through workshops or attended classroom activities at the Environmental Education Center in Alviso and Visitor Center in Fremont. Forty thousand stopped in at the Visitor Center and 11,000 attended interpretive programs. Many more visitors received our self-guided interpretive message when they read our wayside exhibits.

Refuge personnel and volunteers conducted summer day camps at both centers. A total of 94 kids participated.

Two thirds of our 1987 visitors used areas outside of our buildings. The public fishing area, trails and sloughs were used by visitors. Many of these people were contacted in the field by refuge volunteers on patrol.

General public use is limited at the Enviornmental Education Center (EEC). The EEC is only open Monday through Friday between 8:00 am and 4:30 pm due to lack of staff. The number of drop-in

visitors that were observed totaled 5,091, an increase of 49% over 1986. This number represents the absolute minimum of non-group usage by the public. A total of 32 special use groups utilized the EEC. Since the EEC is closed on weekends, a Public Open House was offered. Approximately 400 people attended and joined in the activities offered throughout the day. Many expressed a desire for this area to be open on weekends as this is often the only time families can visit together. In response to this need, the EEC opened on Sundays from July through November. A total of 871 visitors took advantage of the extra visiting days. A special group of 25 high school students and their teacher spent time during the summer refurbishing the small dock on Mallard Slough.

2. Outdoor Classrooms - Students

The Environmental Education Center (EEC) was used extensively again this year. Primary use was school field trips however other groups (such as scouts) also used the facility. During 1987, the Center devoted the first three weeks of September to curricula development as demand for school group use during this time is limited. By the middle of December 1986, all available dates for 1987 spring field trips had been booked. We changed our reservation policy this past summer to try eliminate the canceling problems from teachers booking a year in advance. Fall reservations are taken from August 1 on and spring reservations are taken from December 1 on. We've had very good luck with this new arrangement minimizing field trip cancelations which were hard to fill in previous years. The Center was visited by 225 groups, 7,268 of the participants were students and teachers on all day field trips. This usage represented 44% of the total visitors (16,622). Between July and the end of November, the EEC was open for public visitation on Sundays. Many of the visitors were students, who had been to the EEC on a field trip, returning with their parents. Total visitor usage increased by 70%. Again this year as last year, there is more demand for our program than we are able to meet.

The Center is unique in that the facility is designed to incorporate both laboratory and outside settings for use during the field trip. Teaching aids and laboratory equipment designed to enhance a student's basic observation skills are provided for use during the field trips. Audio visual material, including films, are provided. Field trips involve students in indoor and outdoor activities revolving around a central theme chosen for their field trip. A ratio of 10 students to 1 adult leader is strongly encouraged to provide an enhanced learning experience for all involved. Many new activities including an educator guide, were developed to enhance the learning experience of the students while at the Refuge.

SCA Shawna Cox and Kim Dreyfuss (staff) act out new activity with props to enhance learning about tides.

With only two full-time staff, many of the demands for our programs would go unfulfilled without the aid of Student Conservation Aids (SCA) and a few dedicated volunteers. The volunteers and SCA's learn the basics of the EEC program and then either lead particular activities, present opening and closing programs and/ or provide support to teachers/parent leaders during their activities.

When not helping with visiting school groups, SCA and volunteers are helping the staff with special projects which enhance the educational experience for visitors.

At the Refuge headquarters in Fremont, naturalist-led tours were conducted for approximately 3,569 students and teachers from January to August 1987. It was agreed that 1987 would offer both types of program phasing out naturalist-led programs for school groups by 1988. Both type of programs were offered from September through December 1987. A total of 895 students and their teacher/leaders participated in teacher-led field trips and 590 students participated in naturalist-led field trips. Parents who participated in both type of trips were very enthusiastic about the switch to teacher-led field trips.

The "Marsh-In" day camp was offered for the sixth consecutive year. Two sessions were attended by 32 children. The program is primarily designed to reach children from the nearby community of

Alviso. By involving these children in the EEC and the Refuge we have been successful in gaining acceptance by the local community. Through the day camp, local children gain an understanding on respect for wildlife and the Refuge itself.

A new five day program was developed which included 4-3 hour sessions and an overnight stay. The camp sessions are taught by volunteers, many who have helped since "Marsh In" began. The EEC staff conducts training sessions for the volunteers which introduces the material used during the camp.

3. Outdoor Class Rooms - Teachers

The EEC offers teachers a unique environmental education opportunity. We provide a facility where teachers can lead their own field trip following the training and guidance we provide. Teachers are highly involved in planning the trip, preparing students and conducting the field trips following the individual format designed by the teacher. This format provides both the teachers and students a learning environment which often extends into the classroom beyond the day spent on the Refuge. The EE staff, SCAs and volunteers offer training and support both before and during the field trip. By encourgaing teachers to prepare and conduct their field trips, the EE staff can effectively reach more students with individual attention than had the staff conducted the field trips themselves. A low teacher/student ratio is important to enhance and increase the learning experience.

In the San Francisco Bay area, where many environmental education facilities and programs are available for teachers to choose from, the Refuge EE program is unique from all others. By getting teachers fully responsible and highly involved in their field trip, they are more likely to integrate classroom curricula with their field trip. As a result, students achieve a more meaningful in depth experience. A total of nine 3-hour teacher orientation workshops were offered with 155 individuals participating plus 77 teachers who returned for 1 hour planning sessions. We offered 8 teacher orientations at the Fremont site with 109 participants and thirteen parents came to a special parent orientation. The confidence obtained by the teacher and adult helpers at these orientation workshops is invaluable. Before a field trip to the Refuge can be scheduled, at least one adult must attend the workshop. The staff also is available for individual planning sessions should teachers require assistance in planning their trips. One night a month is reserved for teacher planning sessions. This approach is unique to the San Francisco Bay NWR and is rapidly becoming the teacher's choice of field trip style. This is supported by the fact that several other facilities which only offer staff-led field trips are decreasing in usage while the Refuge usage continues to increase in the face of declining school revenues. A special Teacher Open House was offered with 70 attending the all day program.

This year saw the creation of an Educator's Guide to aid in teacher-led style field trips. The guide was initially developed by an SCA intern and revisions help streamline and improve the document. A draft working copy has been given to teachers during the orientation sessions giving ideas for classroom activities to do at the Refuge. The Educator's Guide has been designed to introduce activities appropriate for either the Alviso or Fremont site.

Project WILD which has generated lots of interest and enthusiam by teachers offers the curricula only through workshops. Four Project WILD workshops were offered with approximately 100 participants. Project WILD is an inter-disciplinary wildlife education program that uses wildlife related instructional activities for grades K-12, whose overall purpose is to conserve wildlife and natural resources.

4. Interpretive Foot Trails

The Refuge has two trails with descriptive panels. These interpretive displays describe the habitat, the cultural history, the ecological dynamics and the geology of the areas that visitors walk through. They are easy to read, visible without being intrusive and serve as a valuable supplement to our interpretive effort.

The self-guided trails are especially important during hours when the Visitor Center is closed. From 5pm to sunset, and before 10am, trail use is often heavy. Other times of heavy self-guided trail use are legal holidays when the Visitor Center is closed. The Tidelands Trail is registered as a National Recreation Trail in the National Trails System.

6. Interpretive Exhibits and Demonstrations

During 1987, 142,000 visitors participated in interpretive activities at the Refuge. 131,000 took advantage of our self-guided interpretive trail or visited the interpretive center to watch films and look at the educational displays. The remaining 103,000 participated in the numerous naturalist-conducted programs such as walks, van tours, talks, slide presentations, and bicycle and canoe trips. The natural history of the Refuge was well represented in our 1987 programs with topics such as salt marsh ecology, insects, birds, seasonal wetlands, endangered species, edible plants, geology and mammals.

Our program audiences were as diverse as the program topics that we presented. Audubon chapters, day care centers, garden clubs, hospitals, scout troops, community groups, senior centers, teachers' associations and women's organizations, among many others, took advantage of the available programs. The greatest demand for naturalist-led activities, however, came from local

schools as students from grades K through college, including special education groups, discovered the wildlife resources of the Refuge and the Bay Area. In 1987, 3,900 students and teachers participated in the eductional programs presented by the naturalist staff and 900 students and teachers participated in he teacher led program.

Also popular were the tours of Drawbridge, an abandoned sportsmen's community in a salt marsh setting. The dilapidated town stands as a reminder of the consequences of human destruction of the native environment. This was the theme as 350 people visited the area during tours offered on Saturdays from May through October.

We also conducted nature walks, talks, slide shows and other interpretive programs for the public on Saturdays and Sundays throughout the year.

Our volunteers were quite active in giving public tours on the weekends during 1987. They covered a variety of aspects of the Refuge including, geology, salt marsh ecology, birds, and astronomy.

Numerous guest weekend speakers provided insight into a variety of topics such as world rainforests, San Francisco Bay sharks, Indian basketry, conservation of natural resources, seasonal wetlands, Gulf of the Farallons National Marine Sactuary Cordell Banks and many more.

Weekend interpretive programs were quite popular and provided a good opportunity to attract families to the refuge.

Many special events were also held at the Refuge during 1987, all with good success. On March 15 - 21, a Saturday and Sunday celebration of "National Wildlife Week" attracted 600 people. Staff and guest naturalists presented programs on birds of prey, snakes, local wildflowers, seals and other nature topics.

Our Kids' Fishing Derby on April 26 attracted hundreds of youthful anglers who visited Dumbarton Pier with their parents to try their luck with hook and line. The local K-Mart donated fishing poles, reels, tackle boxes and other choice fishing gear as prizes for each age group. Winners in each of nine age categories (5 through 12 years of age, and over 12) were awarded a prize.

The Science Fair Open House on June 6 & 7 was a new event which was well received by the public. 350 people attended the Fair honoring the 1st & 2nd place winners of the Fremont Unified School District Science Fair. The winning projects which were displayed for the entire weekend covered such diverse topics as the best car wax, how electricity affects growing plants and lasers and light patterning.

The fishing derby was organized and conducted by the "East Bay Sportsmen", a local fishing club with years of experience in fishing contests. Club members conducted registration, measurement of fish, assignment of prizes, and helpful hints during the day.

On October 17, the California Native Plant Society held a plant sale at the refuge. 350 horticultural enthusiasts visited the refuge to buy native plants for their gardens, or to learn about them at the Nature Plant Symposium which accompanied the all-day sale.

An "Open House", with something for everybody, was held on Halloween, October 31, at the Refuge Visitor Center. 400 people enjoyed film and slide presentations, Drawbridge tours and live music. Special activities, including apple bobbing, face painting and pumpkin decorating, were available for the younger set.

Our annual "Kids' Day" on November 21 was also well received with over 550 kids and parents in attendance. Programs included a live raptor program, birdbanding demonstration, storytelling, films, a program on whales complete with a whale backbone and more.

We held several astronomy programs during the year. Volunteers Bill Delinges and Charles Crouch provided telescopes and expertise for the popular events.

For the first year ever, we presented regularly - scheduled weekend interpretive programs at our Environmental Education Center in Alviso. We kept the Center open to the public all day every Sunday, throughout the summer and into the fall. Several thousand visitors wandered through the building, talked to the naturalist, looked at the exhibits and went along on nature walks.

The potential for using this building on weekends is clear; we hope to pursue this objective again in 1988.

During the summer, 37 third, fourth, fifth and sixth graders participated in the Refuge's 8-week "Junior Naturalist" program. These young nature lovers met at the Visitor Center on Tuesday and Thursday of each week and learned about food webs, adaptations, predation and other ecological concepts as they discovered the worlds of mammals, birds, insects, reptiles, bayshore invertebrates and endangered species. Their response to the program was enthusiastic and positive. We have seen this program having a lasting effect on the participants, as they come back repeatedly to the Refuge to "check-in" and learn more.

Several off-site events helped to increase public recognition of the refuge and its programs. Volunteers staffed information booths at local festivals such as Berkeley Bay Day, the Bay Area Environmental Education Resources Faire, Sulphur Creek Wildlife Day, People Pride and Progress in Newark, the Crab Cove Sea Fair and Wetlands Fair. Throughout the year, staff members spoke to numerous civic, business, church and social groups, providing nearby communities a service while disseminating information about the refuge and its resources. Career talks were frequently given to students at local high schools and intermediate schools. Visitor Center Director Linda Drey-Nightingale served as a judge at 3 Bay Area school science fairs.

Throughout the year, the focus for the interpretive effort was the Visitor Center and the Environmental Education Center which was open during the summer on Sundays. Most of our programs were conducted at these 2 sites and tens of thousands of visitors dropped in at the visitor center reception desk.

Everyday brings a steady stream of inquisitive Refuge visitors past our Visitor Center reception desk. Our volunteers who daily staff the desk are knowledgeable and always willing to help out. We would not be able to present the variety of programs we do without them.

Not all Refuge visitors received a personalized interpretive message. Though it is felt that guided interpretation is the most effective medium for the presentation of information, self-

guided media present information to far more people. The Visitor Center was the focus for self-guided, as well as guided, interpretive activities, and thousands of people during the course of the year saw our displays. We have permanent exhibits on "Wetlands", "Migration", "Offshore Islands", "Estuaries" and "Endangered Species".

One room of the Visitor Center serves to display special exhibits. In 1987 four special exhibits were offered for public viewing. Carried over from 1986 was Smithsonian photographic display of the Farallon National Wildlife Refuge by photographer Tupper Ansel Blake. Mike Nelson's linoleum block prints followed his artistic renderings of local wildlife were a nice change of pace. In May after a gala opening ceremony we unveiled for public display the winners of our own "Picture Local Wildlife" photography contest. These outstanding photographs provided a different view of the Bay area as a home for wildlife. The year ended with a display of wildflowers by photographer Phebe Bush. Each flower pot captured the vibrance of our local flora. These special exhibits invite people to return to the Refuge again and again.

The Visitor Center was kept open on all federal holidays except New Year's Day, Thanksgiving and Christmas.

7. Other Interpretive Programs

The Refuge participated in some non-traditional forms of interpretation. Foremost among these was the production and distribution of a quarterly newsletter, The Tideline. A copy of each issue of the newsletter is included at the back of this narrative. The Tideline was distributed to nearly 22,000 Bay Area households, schools, businesses, churches, hospitals and libraries. It was considered to be our very best means of communicating our program schedules, announcements, news stories, advertisements and editorial comments. In fact many of our programs were filled to capacity by Tideline recipients.

The Tideline was used as a text at a training course for urban managers at the National Park Service's Training Center at Harper's Ferry in West Virginia. It was also used as a supplement to formal text books in many high school biology classes. We repeatedly get requests from biology teachers for subscriptions for that purpose.

Another non-traditional interpretive effort was the Refuge's sixth annual Spring Poster Contest, which attracted 2000 entries by artists in grades K - 6 from the three local school districts. The contest theme this year was "Endangered Species".

First place winners in each grade won free passes for themselves and their parents to Marine World/Africa USA. Second place winners and their parents won a trip to San Francisco Zoo. Third place winners each won a pass for three to California Acadamy of

Sciences in San Francisco's Golden Gate Park. All winners and honorable mentions received ribbons.

We feel that a poster contest is a good way to reach members of the public who might otherwise never make it to the Refuge. These students spent hours (days) preparing posters which advocated the preservation of San Francisco Bay and its wildlife. In the process, each artist may have convinced him/herself that a conservation endeavor is a worthwhile pursuit. This is difficult to measure, but, considering the persuasive, convincing nature of most of the posters, we feel that many advocates of our conservation ethic were either created or reinforced.

In addition, the awareness level of many South Bay students (as well as teachers and parents!) was heightened and many visitors checking in at the reception desk stated that their curiosity had been piqued by the contest, and they were here to see who we were and what we were all about.

1987 was the first year for what we hope to have as an annual event - the Photography Contest. It was run in conjuntion with our cooperating association and had good public response. The theme was "Picture Local Wildlife" and it attracted 1,000 entries in three categories - professional, amatuer and shutterbug (under 14 years). Many of the photographic entries were taken on the Refuge or they were of migrating waterbirds. The grand prize winner received an all-expense paid 8-day whale watching expedition to Scammons Lagoon in Baja. All first place winners went on a local whale watching trip to the Farallon Islands. A Kodak 8000 Disc Camera Outfit was awarded to all 2nd place winners. We received many worthwhile photographs and felt we had reached yet another segment of the public that may not be aware of the Refuge. Hundreds of visitors saw the display of winners and gained a new appreciation for our local wildlife.

In spite of all of the efforts that we made during the year to contact the public, we know that there are many thousands of people out there whose interests do not include endangered species, wetland preservation, migration, waterfowl populations, or anything else along those lines. Reaching these people is one of the most challenging tasks with which the interpretive staff is confronted. And the first step in reaching them is getting them out to the Refuge where they can see with their own eyes what sort of job we are doing.

On 5 and 6 December, we held our sixth annual "Wildlife Arts and Crafts Show". Almost 5,000 Bay Area residents visited the Visitor Center, and read the displays and wayside exhibits as they wandered around and browsed at the artists' booths.

9. Fishing

Public use of the access along the Dumbarton Point Trail (south end of the fishing pier) continued to increase. Use of the Dumbarton and Ravenswood Fishing Piers has greatly increased. Approximately 100,000 anglers used the piers in 1987.

Fishing from or near the piers has netted a variety of fish: leopard shark, sand shark, bat ray, shiner surfperch, bullhead, and the elusive striped bass and white sturgeon.

11. Wildlife Observation

The opportunity to view wildlife in its natural habitat attracts many of our visitors. In close proximity to the Visitor Center is salt marsh, slough, extensive mud flats, open water and upland coastal chaparral, grassland and trees. This range of habitats provides an ideal area for visitors to explore, alone or with our naturalists, when seeking local wildlife.

Some visitors participated in hikes or van tours to Mallard Slough and Triangle Marsh, where marsh-nesting and feeding birds were easily seen. Others were led by a naturalist to Dumbarton Marsh, where the endangered California clapper rail nests. Only when the salt marsh is flooded by a very high tide do these nearly flightless birds emerge from the protective vegetation. Bird watchers revell in these opportunities.

In addition, many nature study groups led field trips to our refuge, and the Audubon Society once again conducted its annual Christmas bird count here. One of the most popular sites for local bird watchers was the restored tidal area, Tract 102, where great numbers of shorebirds and migratory waterfowl gather to feed. There is also a Peregine Falcon commonly sited here.

17. Law Enforcement

The public safety unit operated with four full time officers for the first time since the refuge opened to the public in 1980.

The goals of our public safety unit continues to remain the same- crime deterrence as a short-range goal and crime prevention as the long range goal. As our visitation increases at San Francisco Bay NWR and eventually at several of the satellites both of these goals will remain a chanllenge.

Because of our small staff, patrolling in done selectively depending on previous incidents and the number of visitors using the area. Patrol activities in the North bay were reduced drastically this year. The hiring of an assistant refuge manager with law enforcement authority to work at San Pablo Bay and Antioch Dunes NW Refuges, reduced funding resulting in the loss of overtime to work 10-12 hour shifts, and the closing of Antioch

Dunes to the public resulted in the reduced patrol activities.

A total of 27 refuge permits were issued for controlled activities within 4 of the refuges in the Complex. Permits were issued for gathering biological data, Christmas bird counts, and access for construction activities and various media activities.

Vandalism remained at about the same level as 1986. Interpretive signs on the fishing piers and Tidelands trails were vandalized as were gates, fences and boundary signs. We estimate that our replacement costs were approximately $2,500.00 and labor cost associated with repairs and replacement at $2,700.00. Several interpretive panels on the fishing piers were not replaced due to the cost.

In order to provide a response and coverage after hours a call out list has been established for the four officers. Each officer covers for a three month period. The list is provided to the security alarm service, local police and fire departments, U.S. Coast Guard and the U.S. Park Police.

Refuge officers contacted approximately 10,000 individuals and were involved in 167 incidents during 1987. An incident is an event which occurs on Service lands or is personally encountered by Service enforcement personnel during the course of official duty. Incidents in which the staff were involved are listed in the following tables.

Table 1

Uniform Crime Incidents

Inv. 17-01- Classification	Number	Arrest
05 Aggravated Assult (Refuge Officer)	2	1
06 Burglary (Auto)	1	
07 Larceny	2	
08 Motor Vehicle theft (Joy Riding)	2	2
14 Stolen Property (Auto Recovery)	1	1
15 Vandalism	18	
16 Weapons (Firearm, Martial Art)	17	6
19 Narcotics (Parophenalia)	2	2
22 Driving Under Influence	2	2
25 Disorderly Conduct	2	2
27 Suspecious (Drugs, illegal alien, etc)	6	2
29 Runaway (Juvenile escape)	2	2
Total	66	10

Table 2

FWS Incidents

INV 5-01- Classification	Number
01 Person-Injured/Ill	2
02 Person-Lost	2
04 Possible Drowning	1
06 Suicide	1
07 Property-Found	3
08 Abandoned Property	6
09 Fire Property	3
11 Accident-Traffic	7
13 Traffic Accident (Bicycles)	2
14 Animal Trespass	20
16 Assistance to Citizens	13
17 Assistance to other Organizations	25
18 Unsecure Installation	18
19 Hazardous Area	5
20 Wildlife Carcass	2
Total	110

During the performance of their regular duties, Public Safety Officers made a total of 22 arrests for various warrants and uniform crime incidents.

Officers issued a total of 809 citations this year, down from the all time high of 1,159 last year. A total of $33,321.00 in fines were collected as follows: Federal Court $13,986.00; State Court $19,335.50. This compares to $32,578.00 collected in 1986.

The decline in citations this year can be attributed to several factors. Waterfowl hunting in the Bay area was not as productive, therfore fewer hunters were afield. The Ravenswood "Walk-in" waterfowl area was closed due to dike maintenance. This area supported most of the refuge hunters in the past. Traffic citations on Marshlands Road decreased due to the rigid radar-enforcement program implemented in 1986. Antioch Dunes NWR was closed to public use during 1987. Violations for fishing and related State infractions have numbered up in the 50's in past years. Pheasant and waterfowl populations were down in San Pablo Bay NWR this past year resulting in very low numbers of hunters.

Table 3
Federal Violations

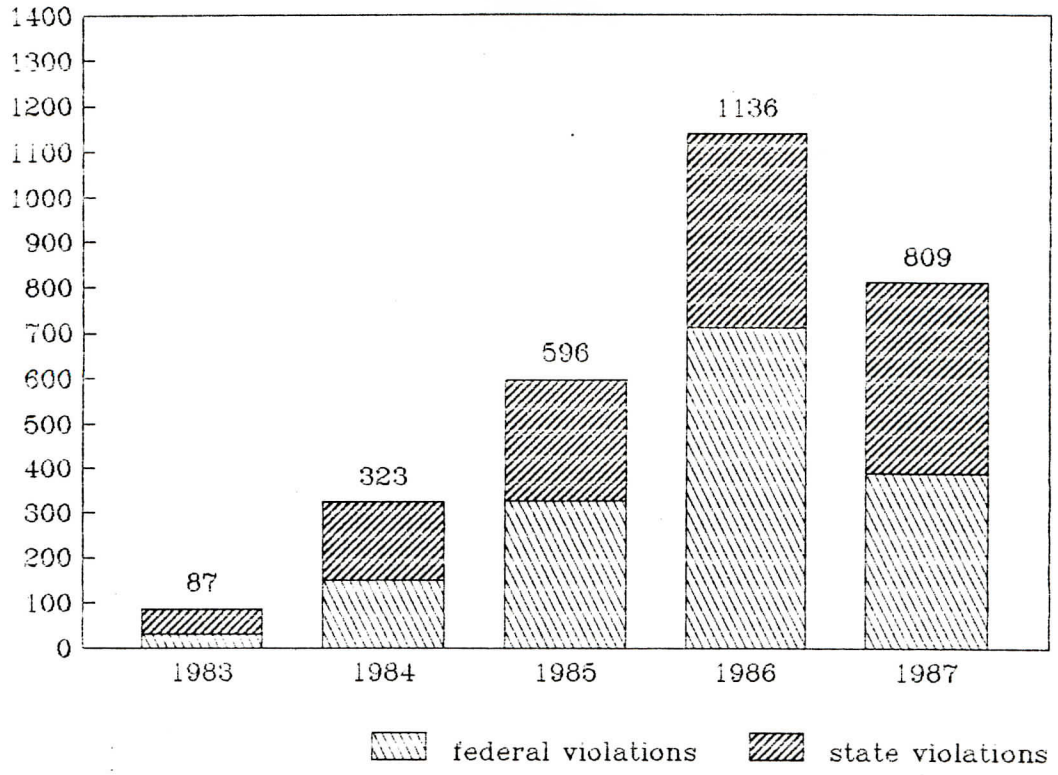
Violation/Section	Guilty	Dismissed*	Pending	Total
Take Migratory Birds-MBTA:				
16 USC; 703	2*	2	0	4
Duck Stamp:				
16 USC; 718A	7	0	0	7
Hunting Methods:				
50 CFR; 20.21b	1	1	0	2
Shooting under power				
50 CFR; 20.21E	1	0	0	1
Late Shooting				
50 CFR; 20.23	1	0	0	1
Daily Limit				
50 CFR 20.24	2	0	0	2
Wanton waste				
50 CFR 20.25	0	2	0	2
Unlawful Possesion				
50 CFR 20.71B	1	0	0	1
Closure Wildlife Refuge				
50 CFR 25.21A	1	0	0	1
Trespass (Person)				
50CFR; 26.21a	91**	0	0	91
Trespass (Dog)				
50 CFR 26.21b	3	2	0	5
Taking Plants:				
50 CFR; 27.21a	5	1	0	6
Vehicles Violations:				
50 CFR; 27.31	9	1	1	11
State law vehicle				
50 CFR 27.31A	17	1	0	18
Careless Driving				
50 CFR 27.31C	0	1	0	1
Speeding				
50 CFR 27.31D	191	3	2	196
License Plates, registration				
50 CFR 27.31F	2	0	0	2
Drivers License				
50 CFR 27.31G	6	4	0	10
Parking				
50 CFR 27.31H	1	3	0	4
Possession Firearms:				
50 CFR; 27.41	13	2	0	15
Possession of Weapons (Non Firearms):				
50 CFR; 27.43	2	0	0	2
Distruction/Removal Property:				
50 CFR; 27.61	3	0	0	3
Delivery Controlled Substance				
50 CFR 27.82B	1	0	0	1

Disorderly 50 CFR 27.83				
Disposal of Waste 50 CFR 27.94	1	1	0	2
Total	361	24	3	388

*2 Found guilty in federal court. Total of $950.00 in fines were levied.

**1 Violator served 1 day in jail, after he was arrested on a $5,000.00 U.S. Magistrate warrant.

***U.S. Magistrates have been issuing $5,000.00 warrants on some coded Federal regulations.


1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
87
323
596
1136
809
1983
1984
1985
1986
1987
federal violations
state violations

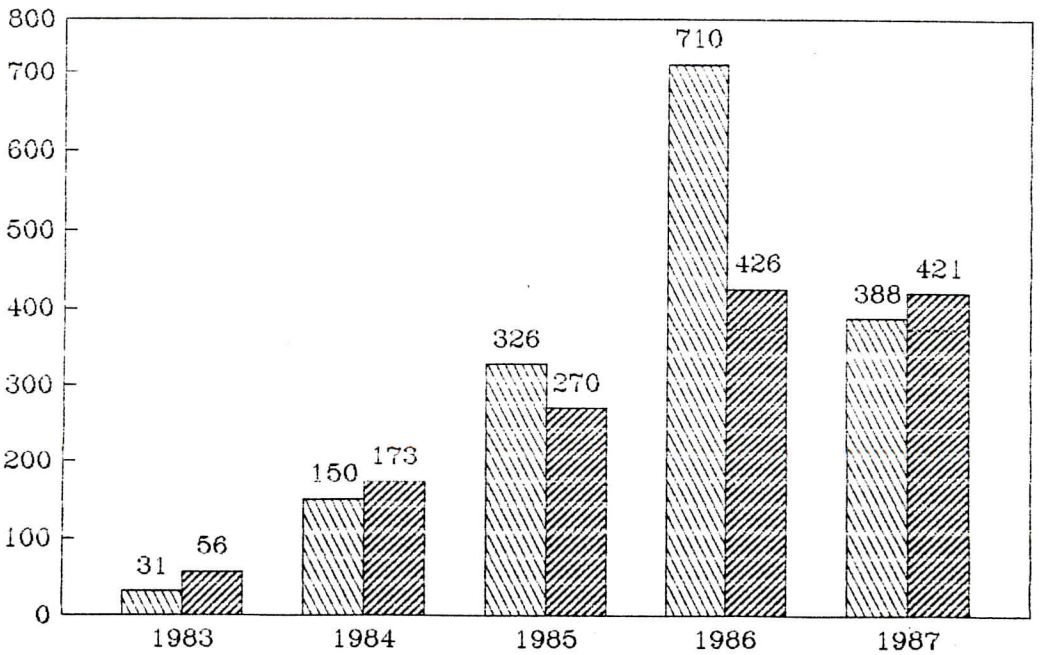

800
700
600
500
400
300
200
100
0
31
56
150
173
326
270
710
426
388
421
1983
1984
1985
1986
1987

Table 4
State Violations

Violation/Section	Guilty**	Pending	Dismissed	Warrant*	Total
Hunting/fishing w/o license					
T14-700	58	13	5	21	97
Inland Water-2 Poles:					
F&G 2.05	36	4	0	1	41
T14-2865a(bay)					
Fishing gear-San Francisco Bay					
T14-28.65b	1				1
Landing Net in Boat-San Francisco Bay					
T14-28.65c	24	1	1	1	27
Undersized Striped Bass					
T14-27.85c	6	0	0	0	6
T14-5.75(d)(1)(b)(2)					
Over Limit-Striped Bass					
T14-27.85b	1				1
Undersized Sturgeon					
T14-5.80c	1	1	0	0	2
T14-27.90					
Undersized Salmon					
T14-27.80d	1	0	0	0	1
Overlimit-fin fish					
T14-27.60a	4	1	2	0	7
Take Dungeness Crabs					
T14-29.85al	2	0	0	1	3
Fishing after hours					
T14-3.00	2	0	0	0	2
Unplugged shotgun					
F&G 311a	6	0	1	0	7
T14-507					
Duck Stamp					
T14-510	1	1	0	1	3
Waterfowl Season					
T14-502	1	0	0	0	1
Shooting hours					
F&G 3000	1	0	0	0	1
Unlawful take					
F&G 2000	0	1	0	0	1
Unlawful Possession					
F&G 2002	0	1	0	0	1
Fail to show on demand					
F&G 2012	0	2	0	0	2
Take game from another					
F&G 2011	1	0	0	0	1
Hunter Treaspass					
F&G 2016	3	2	0	2	7
Migratory Bird Treaty Act*					
F&G 35b	2	0	0	0	2
Take Protected Birds					
F&G 3511	2	0	0	0	2

Littering w/in 150' of water F&G 5652	3	0	1**	0	4
Fremont Muncipal Code Shooting in City Limits 3-3106	3	0	1	0	4
Menlo Park Municipal Code Parking 11.20.020	3	0	1	0	4
Harbors and Navigation	1	0	0	0	1
Business & Professions Code	0	0	1	0	1
Health and Safety Code	0	0	1	0	1
CA Penal Code	15	4	4	5	28
CA vehicle Code	121	24	13	4	162
Totals	421	55	31	36	421

*Juvenile violators
**Found not quilty
***3 found not guilty, 3 dismissed for plea bargain in other cases

Citations were written for a total of 220 Fish and Game violations and 201 violations of all other types. The Fish and Game citations resulted in $7,205.00 in fines, 5,441.00 in outstanding warrants, six and a half years probation, and 14 days in jail (ten days were suspended). There were also 51 hours of community Service required of violators. 53 violations were given suspened sentences for fish and game violators. All other codes yielded $12,130.50 in fines, $4,500.00 in outstanding warrants. 3 years 90 days probation, and 82 day in jail with 30 days suspended. Violators were also required to spend 5 hours community service. Sentence were suspended for 35 violators. One air rifle and two hunting bows with arrows were ordered forfeited.

18. Cooperating Associations

A major change occurred at San Francisco Bay National Wildlife Refuge during 1987--on July 1, we formally severed ties with Coastal Parks Association, and San Francisco Bay Wildlife Society began operating.

Coastal Parks Association, based at Point Reyes National Seashore 70 miles away, had operated our book sales outlet and provided administrative services since 1979. Book sales had grown steadily during that time; gross, taxable sales totaled $2,000 the first year and grew to $15,000 in 1986 (the last full year of Coastal Parks Association management here).

By 1986, our sales volume was large enough to justify the creation of a new, non-profit corporation that would be located at the refuge, and whose first and only goal would be to enhance the quality of nature programs at the refuge. In January, Refuge Manager Rick Coleman and Park Ranger John Steiner attended

Coastal Parks annual board of directors meeting to announce our intentions and to elicit a large measure of financial support.

The board of directors was enthusiastic about our proposal. They agreed to assist us with our separation, and to lend us the sales inventory, as it would exist at the time of separation. This interest-free loan would allow us to begin operating at top speed, with a complete sales inventory already in place. Coastal Parks also agreed to give the new association all of the sales equipment that it owned at the refuge. It was then left to us to actually create the corporate structure necessary to establish San Francisco Wildlife Society.

Corporate law is beyond the expertise of any of the staff at the refuge. The Bay Area is crawling with lawyers, though, and we only needed one of them to donate the time and legal skill to draw up our papers. Oakland attorney Jed Somit readily agreed to lend his assistance, free of charge, and on February 10, 1987 we filed our articles of Incorporation with the California Secretary of State. We declared ourselves to be a non-profit, public benefit corporation set up for chartiable purposes only. As such, we could be exempt from state and federal income taxes.

We applied for those exemptions, and received them by Spring. San Francisco Bay Wildlife Society was now officially a non-profit corporation under Section 501 (c)(3) of the Internal Revenue Code. Not only were we exempt form income taxes, but donations to the Society were tax deductible for the donors.

In the meantime, we had drafted by laws, written a cooperative agreement with the U.S. Fish and Wildlife Service, obtained liability insurance and appointed nine directors from the local community.

Our attorney advised us to recruit as diverse a group of directors as possible. This would strengthen the Society and enlarge the board's collective area of expertise. We assembled a group of community leaders from business, government and acadamia who were willing to give up a significant portion of their time to help the Society get going.

The first meeting of the Board of Directors of San Francisco Bay Wildlife Society was called to order at 7:00pm on May 11, 1987. The Society's by laws were adopted; officers were elected; the corporate seal was approved; the accounting year was established (October 1 through September 30); a bank account was considered; tax exemptions were explained; official responsibilities and duties were enumerated and clarified; a quorum was defined; and assemblage of customary, first-meeting resolutions and motions were formally made, seconded and unanimously carried. The meeting was adjourned amidst feelings of euphoria, good will, altruism and great expections.

An audit was conducted by accountants for Coastal Parks Association on July 1, which established both the absolute value

of the inventory loan, and the first day of retail sales by the new Society.

Long-time volunteer Edna Bohanon became the manager of the bookstore; she would operate under the guidance of Linda Drey, the Visitor Center Director. Business was very good. By year's end, Edna's and the other volunteer's and staff members' efforts resulted in total receipts, from all sources of revenue, of $20,454.54!

Income comes from the following different areas. Most important is book sales, wholesale and retail.

When we left the old association, we acquired all of the unsold publications which had been developed by Coastal Parks Association at the refuge's request. There was a checklist to the birds of San Francisco Bay Region, a post card strip depicting bayshore habitats and associated wildlife, and Exploring our Baylands, an interpretive book on local salt marsh ecology. Lots of bookstores, nature centers, museums and parks sell these items, which we sell to them at reduced cost.

Retail book sales is the single largest source of income. In December, we had the largest sales day in our history (over $900) and our largest-ever sales month ($3,400)!!

We also make money from memberships. We ended the year with 254 members (one of them was Congressman Don Edwards) who paid between $5 and $100 to join. Developing a roster of paying members is important for three reasons: first, the dues payed is an important revenyue source; second, people committed to our goals enough to pay the dues can constitute a potent political force; and third, these people are targeted as a continuing donor base.

Donations are a minor, but growing source of money. The Society actively solicits contributions on our widely-distributed membership application printed in the Tideline newsletter. We also have a donations box in the Visitor Center. Finally, we request donations from corporations, which occasionally respond.

The last source of money for the Society is our Christmas Arts and Crafts Sale fund raiser. Thousands of visitors come to the refuge for this annual event, and the cooperative association makes money from artists' registration fees, commission on art sales, a raffle and food service. The art show is described in detail in Section H.7.

Such are the sources of income. The Society also has many expenditures, which are determined by the requirements of operating the book sales business and/or by the approval of the directors. In 1987, San Francisco Bay Wildlife Society spent money to print the Tideline(see Section H.7), to establish a petty cash reserve for incidental expenses, to construct benches for the Pump House (see Section H.2) and for interpretive program

supplies. At year's end, we were preparing to purchase a new cash register, thanks to an interest-free loan from the Kilauea Point Natural History Association.

Director Sandra Kinchen took charge of administering the Society memberships. She set up a membership booth at the art show and did land-office business for two days, signing up local citizens who wanted to contribute to a worthy cause. She continues to process applications, register new members, correspond with inquisitive potential members, and handle the memebership dues.

Our future during 1988 is clear. The Society will continue to grow (perhaps opening a sales outlet at another wildlife refuge) and to finance the interpretive effort at San Francisco Bay National Wildlife Refuge. We will be actively involved in environmental education and wildlife interpretation, and will continue to seek out interested people from the community to lend a hand.

This is what San Francisco Bay Wildlife Society is all about - funding nature programs, involving the community, creating a wildlife refuge constituency. Such is the challenge, and the reward, of interpretation.

I. EQUIPMENT AND FACILITIES

1. New Construction

The California Department of Transportation ("Caltrans") undertook some major construction projects on the Refuge, as part of its multi-year program to convert the old Dumbarton Bridge to fishing piers and remove or convert all bridge-related facilities to Refuge use. The toll plaza was demolished, and associated light poles, barricades, signs, etc. were removed. The road in the toll plaza area was narrowed from four lanes to two, repaved and restriped; excess pavement was ground up and left in site. A new driveway was constructed connecting Marshlands Road directly with the Visitor Center parking lot and the former circuitous driveway was ground up. An area behind the toll office was graded, paved and fenced to create a storage yard. A sewer line was installed between the toll office and a nearby manhole to replace the defunct septic tank system, but was not connected due to a snafu concerning permits. A trail was constructed between the Refuge and Coyote Hills Regional Park; it was dedicated in a multi-agency ceremony on April 15. Finally, the Dumbarton Pier entrance and parking lots were landscaped. All of these projects were done at Caltrans' expense, except that the Refuge contributed to the cost of fencing the new storage yard.

Refuge maintenance staff installed irrigation sprinklers at the new trailhead and a water line between the toll office and former Leslie Salt Company pumphouse (approximately 600 feet).

2. Rehabilitation

A vacant Leslie Salt Company pumphouse which was transferred to the refuge in 1983, received futher rehabilitation as part of a long-term program to convert it into an environmental education facility. Maintenance staff built and installed a 30-foot counter along one wall of the building, providing desk and storage space for up to fourteen students at a time. Staff also installed interior window trim, a sink (cold water only) with storage cabinet below, and an outside slop sink and hose bib.

The entire electrical system in the old Bayside Canning Company building in Alviso was replaced in August. All old curcuit breaker panels, outlets, conduits, wiring and light fixtures were removed, and new ones installed. The job was done by American Electric Company of Fremont, CA at a cost of $15,000.

Work continued in coverting the old Dumbarton Bridge toll office building to Refuge uses. Maintenance staff converted the inside bathrooms to storerooms by removing sinks and toilet fixtures, painting the walls and ceilings, installing window bars and constructing shelves. A building intrusion alarm was installed as well.

All wood work on the two 13-foot Boston Whalers was removed, stripped, sanded, stained, varnished and reinstalled. The woodwork on these boats had not been given any attention since the boats were purchased in the 1970's, and was badly deteriorated from exposure to sun and salt air. The boats are now covered whenever stored outdoors.

Finally, Lexan panels were replaced over three interpretive signs on the Ravenswood Pier after an unknown visitor "borrowed" and forgot to return them. The Lexan helps protect the signs underneath from vandalism. The new plants were attached with double-sided foam tape and screws.

3. Major Maintenance

The Refuge maintenance staff performed a significant amount of work in conjunction with the Caltrans projects described in Section 1, above. Construction debris was buried or hauled away, and areas adjacent to the road and trail were graded and seeded. The trail was signed, trailsides cleared of brush and adjacent fences either repaired or removed. Maintenance staff removed pavement tailings from the old driveway, fenced it off and seeded the area.

The engine of the Case 380 wheel tractor was completely overhauled, after it seized up due to a spun rod bearing. The tractor was trucked to Modesto, where the work was done by Case Power and Equipment Co. for $5,822.65, after local repair shops turned in much higher estimates.

Maintenance contract data for 1987 are as follows:

Heating System Maintenance Contracts for FY87 were:

Headquarters

George A. Fincer — Amount: $1460.00
14336 Wiley Street, San Leandro, CA

Environmental Education Center

G.J. Yamas Co., Inc. — Amount: $1636.00
#1 South Linden Ave.,S. San Francisco, CA

Janitorial Contracts for FY7 were:

Headquarters/Environmental Education Center

Nova Commerical Co., Inc. — Amount: $11472.00
321 Merrill Ave., Fremont, CA

The service will be performed seven days a week at the Headquarters and five days a week at the EEC.

Building Security Contracts for FY87 were:

Headquarters/Environmental Education Center

Security General — Amount: $5916.00
848A Stewart, Sunnyvale, CA

Maintenance contracts for the Dumbarton and Ravenswood fishing piers for FY87 were:

California Land Management — Amount: $69,600.00

Contracting for 10 Port-a - on the fishing piers was awarded to:

Acme Sons & Sanitation — Amount: $7200.00
P.O. Box 1343 Street, Campbell, CA

4. Equipment Utilization and Replacement

The Refuge acquired a Kawasaki "Bayou 300" four-wheel ATV, a Panther 15-foot airboat and a Mariner 25-horsepower outboard motor in 1987. The Refuge also acquired a 1967 Warner-Swasey Grade-All as surplus equipment from the U.S. Navy. The Grade-All is inoperable condition, and will be used for marsh management and levee maintenance once an employee is trained in its use.

During 1987, the Refuge disposed of a 1973 International Harvestor "Scout", a 1974 Dodge station wagon (known to staff as the "mean gree machine") and a 1977 Chevrolet "Suburban".

5. Communications

A public telephone was installed at the Dumbarton Pier for reasons of safety and public convenience.

A CA Department of Fish and Game surplus radio was installed in one of the law enforcement vehicles, permitting direct interagency communication.

6. Energy Conservation

Maintenance staff installed ceiling fans in the Visitor Center and second-floor office. During winer, these help to circulate heated air which rises to the ceilings (in some places over 20 feet high). In summer, the fans keep air circulating throughout the building and provide some cooling effect. In addition, a door between the office and visitor center is kept open on hot days to promote air circulation, and closed on cold days to keep heated air from moving upwards through the building and out through the Visitor Center doors.

7. Other

During 1987, the Refuge warehouse/shop moved into 25% larger quarters at no increase in rent. Both locations are in the same complex of "tip-up" buildings on Cedar Boulevard in Newark, CA. The new warehouse is equipped with a hose bib and 220 VAC electric service, both of which were lacking in the old location.

The overlook in front of the Visitor Center entrance was modified in the interest of safety. Since it opened in 1979, several visitors have tripped on the overlook's entrance steps while gazing at the view. To solve this problem, the steps were filled in level with timbers and blocked with a row of benches. Visitors now enter the overlook via the handicapped access ramp.

J. OTHER ITEMS

3. Credits

While the entire staff had input and assisted in roughing out this 1987 edition, the following staffers were responsible for the various sections as follows:

Section A,
Sections B, C, D, E 1, 2, 5, 8 - Ben Crabb
Section E 4 -
Section E 6 - Bob Bolenbaugh
Section F & G -
Section H 1 - John Steiner, Debby Johnston
Section H 2, 3 - Debby Johnston
Section H 4, 5, 6, 7, 11, 12, 13, 14 16, 18 - John Steiner
Section H 8 -
Section H 9 -
Section H 17 - Ben Crabb
Section I - Steve Lewis, Mike Bitsko.

Editing was done by Ben Crabb and Chalotte Cox and Kathy Zeliff typed and put this "history of 1987" together.

SAN PABLO BAY NATIONAL WILDLIFE REFUGE

Sonoma and Solano Counties, California

ANNUAL NARRATIVE REPORT

Calendar Year 1987

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

San Pablo Bay NWR was established in 1974 to protect bay wetlands for endangered species, waterfowl and shorebirds. This refuge consists of approximately 11,700 acres along the north shore of San Pablo Bay in Sonoma and Solano Counties, California between the Petaluma and Napa Rivers. Habitat types are made up largely of open water, mudflats, and salt marshes.

Almost 95% of San Pablo Bay's tidal marshes have been levied or filled. The remaining wetland habitats support abundant fish and wildlife species. It provides major wintering habitat for shorebirds and waterfowl, particularly diving ducks. Major developments in the bay system such as hydraulic mining, diking and filling of marshes, water diversions, and agricultural and industrial uses have all had tremendous impacts on the Bay ecosystem.

Lower Tubbs Island was donated to the refuge by The Nature Conservancy after the area was acquired in 1969 to prevent the area from being converted into an oil storage depot. As a condition of the donation, Lower Tubbs Island is closed to hunting, however, wildlife observation is allowed for people willing to hike into the area.

INTRODUCTION

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G. WILDLIFE

H. PUBLIC USE

I. EQUIPMENT AND FACILITIES

J. OTHER ITEMS

K. FEEDBACK

A. HIGHLIGHTS

--The refuge received $35,000 to carry out a contaminant action plan in FY 87 (Section D. 5).

--Nearly 30,000 ducks were surveyed on San Pablo Bay in January 1987, including 10,556 scaup and 2,457 canvasback (Section G. 3).

--A right-of-way request was received from MAre Island Naval Shipyard to cross a portion of the refuge with a powerline (Section E.8).

--The pile of debris near the "Troll House" was burned during May (Section F.9).

--Marin/Sonoma Mosquito Abatement District requested that the water control structures on Lower Tubbs Island be rehabilitated (Section D.2).

B. CLIMATIC CONDITIONS

The climate is a Mediterranian type with cool wet winters and warm dry summers. Average annual rainfall is approximately 20 inches, reaching a maximum of 50 inches in the upper reaches of the watershed. Average for the majority of the area is 35 inches. Mean annual temperature is 60-62 degree F, plus or minus about 10 degrees for summer and winter months, respectively.

Rainfall during the winter of 1986-87 was below average. Habitat conditions on the refuge were not greatly impacted by the drought since most of the refuge is tidally influenced.

C.LAND ACQUISITION

3.Other

Personnel from the Regional Office Realty Office spent one day collecting information on the Cullinan Ranch as a preliminary step in the possible acquisition of this site. The property is located north of Highway 37 and west of the Napa River. Currently, the ranch is kept dry by a series of ditches and levees. If acquired, the ranch would provide excellent opportunities for restoring wetlands in an area that has lost a large percentage of this habitat type.

D. PLANNING

2. Management Plan

The management plan for San Pablo Bay NWR was completed and submitted to the Regional Office for approval.

An amended Project Description Worksheet was submitted to the Regional Office to request funding for rehabilitation of water control structures on Lower Tubbs Island as a FY1988 ARMM's project. The structures were damaged by severe winter storms two years ago and this has hampered ability to effectively manage water levels. Marin/Sonoma Mosquito Abatement District has developed a water regime that has eliminated the need for spraying of pesticides to control mosquitoes. However, damage to the water control structures is making it increasingly difficult to maintain the proper muted tidal action within the Lower Tubbs Unit.

5. Research and Investigations

Contaminants in San Pablo Bay NWR

Continuing contamination of the San Francisco Bay estuary by organic and inorganic compounds may be adversely affecting bay and refuge wildlife resources. However little is known about contaminant levels in key wildlife species of concern. Fish and Wildlife Service studies have documented elevated levels of selenium and some heavy metals in surf scoters, with some at the highest levels recorded in the North Bay.

Contaminant action plans written in 1986 for four of eight refuges in the complex resulted in special funding to carry out plans in FY 87. A total of $98,000 was provided, including $35,000 to investigate contaminants in San Pablo Bay NWR resources. Refuge activities are being coordinated with Ecological Services, Research, and California Department of Fish and Game personnel, since all are involved in contaminant investigations in the bay.

Refuge efforts are concentrating on investigating contaminant levels in key species, specifically the endangered California clapper rail, diving ducks (canvasback and scaup), and invertebrates (preferably food organisms). The refuge will use canvasback and scaup collected by the State for selenium analyses to determine heavy metal and organochlorine levels.

Scaup and canvasback collected during 1986-87 were processed by refuge biologists and volunteers during August. Samples were sent to private labs for analysis.

During 1987, 5 clapper rail, 4 mallard and 1 gadwall eggs were collected by refuge biologists throughout Bay Area marshes. As during 1986, the eggs were submitted for contaminant analysis. In addition, 15 sediment samples and 9 ribbed horse mussels were collected from San Pablo Bay for contaminant anaylsis. Results will be used to better define the extent of contaminants in wildlife species of special concern.

E. ADMINISTRATION

1. Personnel

San Pablo Bay NWR is administered as a subunit of San Francisco Bay NWR. As such no personnel are stationed permanently at this site.

5.Funding

Funding for this refuge is accounted for under the San Francisco Bay NWR complex budget. An ARMM's project involving rehabilitation of water control structures was included on the FY1988 budget in the amount of $26,000.

8. Other Items

A revenue sharing payment in the amount of $2,304.00 was presented to Sonoma ($1,211.00) and Solano ($1236.00) Counties during 1987.

A powerline right-of-way request from the Navy was reviewed and submitted to the Regional Office for concurrence. The powerline is designed to act as a back-up system to the primary line that currently feeds Mare Island Naval Shipyard. The powerline as originally described would have covered only 50 feet of the refuge. After the review was completed the Navy notified us that a new survey of the line showed the powerline would not cross the refuge after all. The proposed powerline corridor crosses the Cullinan Ranch which is being considered for acquisition. The request was routed through the Sacramento Ecological Services office for review. The ES office took a strong stand against the powerline based primarily on the potential impact on migrating birds. As of the end of 1987, this issue had not been resolved.

F. HABITAT MANAGEMENT

2. Wetlands

The year was unusually dry but this did not greatly affect refuge water management since all areas are tidally influenced.

Habitat conditions on Lower Tubbs Island have been enhanced by water management that eliminates the need to spray for mosquitoes. This photo illustrates the pickleweed marsh of the refuge on the left and agricultural fields (former tidal areas) on private lands to the right.

The Marin/Sonoma Mosquito Abatement District proposed a project to rehabilitate the water control structures on Lower Tubbs Island as discussed under Section E.8. The damage to the structures includes twisting of the culverts, sloughing of riprap material in front of flap gates, and loss of electrolysis plates on the gates. The inner levee structures are in danger of popping out of the ground due to erosion caused by backwash. Bulkheads are needed to counter act this problem. An ARMM's proposal for $26,000 was approved for FY1988.

8. Haying

In 1983 we had the production of oat hay by the adjacent landowner stopped so that the area could revert to a more natural grassland. This area is gradually recovering. It received heavy use by raptors and pheasants. Small coyote bushes (Baccharis pilularis) provided additional cover.

9.Fire Management

A pile of debris that represented the remains of two buildings that had been demolished was burned during May. Metal scraps were picked up and transported to a landfill. Winter rains resulted in a new growth of vegetation and by year's end the scars were already healing.

10. Pest Control

Mosquito production on Lower Tubbs Island has been brought under control with the construction of tidal circulation ditches and water control structures. Mosquito production in other non-manipulated tidal marshes on the refuge still is a problem. We are continuing to work with the local mosquito abatement district to resolve these problems. In 1985 the Fish and Wildlife Service entered into a cooperative agreement with the Marin/Sonoma Mosquito Abatement District for construction of a ditching system using draglines and Sprite ditches.

Work began on this project during the summer when a sprite ditch was dug connecting Lower Tubbs Island ponds with Tolay Creek in the vicinity of the old agricultural field. Material excavated from the ditch will be stacked just west of the road to form a barrier for flood waters from Tolay Creek entering adjacent farm

Maintenance men Mike Bitsko and Steve Lewis assessing the pile of debris prior to burning (Munoz).

Debris was burned to improve the aesthetics of the area. Suppression equipment was stationed next to the "Troll House" which is on private property (Munoz).

lands. This activity was permitted by the proper regulatory agencies and will proceed in 1988. This project will benefit the refuge by restoring tidal flow into an area that is only occupied by sparse ruderal vegetation. Tidal flow should restore conditions favorable to the establishment of pickleweed.

Cooperative approaches to mosquito control in the marshes which fall in Solano County (eastern marshes) have not been as successful. The Solano County Mosquito Abatement District (MAD) sprayed these marshes twice in early 1986 using a low concentration of Dursban to prevent mosquitoes from reaching the nearby town of Vallejo. In an effort to reduce the need for chemical control, the refuge (supported by Solano MAD) proposed that adjacent landowner Leslie Salt Company breach their intake channel levee. Such a move would meet objectives desirable by all: 1) mosquitoes would be controlled by tidal flushing in the adjacent marsh, reducing costs of chemical control and impacts on wildlife and habitat, 2) wildlife habitat would be enhanced, and 3) the intake channel would be kept clear by scouring action. Discussions regarding this proposal were begun during 1986. The ball is in Leslie Salt Company's court and no action one way or the other had been taken by year's end. Another meeting will take place on this subject during January 1988.

G. WILDLIFE

2. Endangered Species

The salt marsh harvest mouse and California clapper rail are resident endangered species on the refuge. Past studies of the harvest mouse have shown that good numbers of this species are present in the tidal marshes throughout the refuge and there does not appear to be any imminent threat to this population. There has been very little study of the clapper rail population on the refuge. A collection of 5 clapper rail eggs was collected by refuge staff in spring - summer 1987 for contaminant analyses in the general vicinity of the refuge. North Bay samples are of particular interest due to the extensive industrial discharges occurring there. Eggs were processed and submitted to Patuxent Wildlife Research Center for analyses.

Peregrine falcons and California brown pelicans were observed on the refuge again this year in typically small numbers.

3. Waterfowl

Traditionally, San Pablo winters more canvasbacks than any other location in the western United States. The long term average is approximately 53% of the Pacific Flyway population with a range of 26% to 90%. Many factors influence the number using the bay, the most important being flooding in the Sacramento-San Joaquin Delta and the Central Valley. During the past several years early flooding in these areas has resulted in a relocation of approximately 2/3 of the average wintering population to these flooded agricultural lands. However, no flooding occurred during the 1986-87 waterfowl seasons.

The annual mid-winter waterfowl survey was completed on 3 January 1987. Aerial surveys were conducted over San Francisco and San Pablo Bays, and coastal Marin and Sonoma Counties. Total for the San Pablo Bay area was 29,361 waterfowl.

Monthly waterfowl surveys were initiated by Louise Accurso and Jean Takekawa in the 1987-88 season to provide more data on seasonal changes in Bay waterfowl populations. Table 1 lists the results of these flights.

5. Shorebirds, Gulls, Terns and Allied Species

The mudflats of San Pablo Bay provide important feeding habitat to hundreds of thousands of migrating and wintering shorebirds. During high tides the shorebirds retreat to adjacent diked pasturelands (historic marshlands) which serve as seasonal wetlands to continue feeding or for roosting. Currently there are several proposals to convert thousands of acres of these pasture/haylands into housing or industry. If allowed to occur the carrying capacity for shorebirds in San Pablo Bay will probably decrease significantly, especially for peeps.

6. Raptors

Raptors are abundant on the refuge, especially near Tubbs Island where sizeable grass and pasture lands border the wetlands. Nesting species include northern harrier, short-eared owl, barn owl and burrowing owl. Other species observed include great horned owl, red-tailed hawk, Cooper's hawk, and golden eagle. Peregrine falcon, merlin and bald eagle are occasionally seen on the refuge.

TABLE 1. Total Waterfowl Numbers For San Pablo Bay Area

	20 Oct 87	9/10 Nov 87	9/10 Dec 87	3 Jan 88
Canvasback	25	601	381	2,457
Scaup	81,377	57,251	25,460	10,556
Bufflehead	3	0	38	82
Ruddy Duck	562	2,951	156	533
Scoters	13,623	14,180	16,032	5,168
Mergansers	0	0	0	2
Coot	183	78	12	22
Mallard	0	11	20	90
G.W. Teal	0	10	325	171
Cinn. Teal	0	0	0	2
Pintail	0	1	167	8,820
Shoveler	0	0	290	189
Gadwall	0	0	0	179
Widgeon	0	0	0	1,002
Unident.	0	913	135	88
TOTAL	95,773	75,996	43,149	29,361

San Pablo Bay provides important wintering habitat for canvasbacks. This picture illustrates a typical concentration of canvasbacks in the open bay (Munoz).

Monthly aerial surveys conducted by Louise Accurso and Jean Takekawa included estimates of ducks using San Pablo Bay such as the surf scoters in this photo (Munoz).

9. Marine Mammals

Approximately 20 harbor seals continued to use the haul-out site at Long Point on Lower Tubbs Island. There is still no indication of breeding at this site.

12. Wildlife Propagation and Stocking

Immediately adjacent to the Tubbs Island Unit of the refuge is the Black Point Game Hunting Club, which is a state-licensed, private pheasant hunting club. From October through March hunting is allowed for club members. During this period, pheasants are released by the club and many of the birds accumulate on the refuge where they are not pursued, except during the Statewide general hunting season whwich runs for three weeks from mid-November through early December. As a condition to the state club license, the club is required to release pheasants on their area in April after the hunting season. Many of these birds also end up on the refuge, however, survival of the released pheasants is extremely low due to their susceptibility to raptor predation. The presence of pheasants on the refuge would probably cease if the club terminated operations.

H. PUBLIC USE

1. General

The Refuge was open to waterfowl and pheasant hunting on the State leased tidelands and Tolay Creek. Hikers, birders, photographers and school groups were permitted to use Lower Tubbs Island.

6. Interpretive Exhibits and Demonstrations

Tours into Lower Tubbs Island were conducted periodically throughout the year. Individuals wishing to participate make reservations at the headquarters in Fremont and meet the van at the refuge entrance. Since San Pablo provides excellent birding, enthusiasts take advantage of these trips.

8. Hunting

Pheasant hunting along Tolay Creek on Lower Tubbs Island has increased over the past several years as word has spread about the availability of this hunting area. The pheasants are not wild stock, but are released on a nearby commercial hunting club. Huntable habitat only amounts to about 100 acres. Approximately 60 hunters were present on the opening day of pheasant season. The average was much less than 1 bird per hunter.

Approximately 250 hunters used the Tolay Creek area (State Land Coimmission Lease lands); no hunting is permitted on the portion

of Lower Tubbs Island donated to the Service by the Nature Conservancy.

Waterfowl hunting occurs in the open water and mud flats on the remainder of the Refuge. Access is limited to boats only. The main species harvested were scaup, ruddy ducks, buffleheads and canvasback.

17. Law Enforcement

Because of staff limitations and budget constraints, we respond to this refuge on opening weekends of the hunting season and when called by the visiting public or cooperating agencies.

The number of hunters and fishermen using the open waters of the refuge have shown a gradual decline the past few years as the number of target shooters increase along State Highway 37 on private property lying to the north of the refuge open-bay area. Most target shooters are using pistols and rifles (.22 to 30-06).

We are continuing to work with Leslie Salt Company and the Solano County Sheriffs office to keep the private property posted and patrolled. The only real solution to this problem is our eventual purchase of the Leslie property and settlement of a condemnation action against the other private landowner.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Water control structures on the outboard levees are constantly exposed to strong wind and tidal action. Some are no longer functional due to the resulting damage. A proposal to rehabilitate the water control structures on both the outer and inner levees was made by the Sonoma/Marin Mosquito Abatemant District. The outer levee structures need, 1) removal and replacement of riprap that has sloughed off in front of the gates, 2) construction of bulkheads on the bay side of the levee, 3) securing the structures to the bulkheads, and 4) replacement of the zinc electrolysis plates that protect the gates. The inner levee water control structures need, 1) construction of bulkheads to eliminate erosion due to backwash, and 2) placement of fill material to replace ground that already has eroded. A $26,000 ARMM's project was approved to accomplish this work during FY 1988.

J. OTHER ITEMS

3. Credits

This report was written by Dick Munoz who relied on information prepared in previous years by Jean Takekawa, Donna Stanek and Ben Crabb. The report was typed by Kathy Zeliff.

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

Contra Costa County

ANNUAL NARRATIVE REPORT

Calendar Year 1987

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Antioch Dunes NWR was established in 1980 to protect a unique dune riverine ecosystem. Located along the San Joaquin River, the refuge encompasses approximately 55 acres divided into two separate tracts, known as the Stamm (41 acres) and Sardis (14.29 acres) Units. This refuge contains flora and fauna found nowhere else in the world. Two endangered plants and an endangered butterfly receive protection on this refuge. These few acres of remnant dune habitat support the last natural populations of Antioch Dunes evening primrose, Contra Costa wallflower and Lange's metalmark butterfly.

Very little of the original dune habitat remains. The majority has been lost through industrialization, sandmining, agricultural conversion, off-road vehicle use, and other human disturbances. These practices are responsible for the introduction and encouragement of exotic plants, which has significantly altered the remaining dune habitat.

Antioch Dunes NWR represents the first refuge in the United States established to protect endangered plants and insects.

INTRODUCTION

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K. FEEDBACK

A. HIGHLIGHTS

--Census results for the endangered Antioch Dunes evening primrose, Contra Costa wallflower and Lange's metalmark butterfly indicate all species are increasing in numbers (Section G.2).

--Refuge volunteers and California Conservation Corps workers planted 8000 buckwheat seedlings on the refuge to benefit Lange's metalmark butterfly (Section F.6).

--Two wildfires burned on the Stamm Unit during 1987 (Section F.9).

--Research on endangered plants was initiated by Bruce Pavlik of Mills College (Section D.5).

--The parking lot at the Stamm Unit was closed to vehicle access to eliminate a severe littering problem (Section H.16).

--Cooperation between Pacific Gas & Electric (PG&E) officials and the refuge staff has resulted in many benefits for management of the endangered species found on the refuge and on surrounding PG&E land (Section E.8).

B. CLIMATIC CONDITIONS

The refuge and vicinity have a Mediterranean climate, with warm to hot dry summers and moist cool winters. Summers are slightly warmer and winters slightly cooler than San Francisco Bay NWR and San Pablo Bay NWR located nearby.

Temperature and precipitation data were collected at the Antioch Water Treatment Plant located near the junction of A Street and Highway 5. Precipitation is recorded from July 1 to June 30 to better reflect the totals recorded during the rainy season (December through February). Total precipitation for 1986-87 was 8.28 or 3.72 inches lower than the average. Precipitation for the previous three seasons was 21.03, 12.42 and 12.43 inches, respectively. The figure for 1987-88 was 5.81 inches as of the end of 1987.

D. PLANNING

2. Management Plan

A management plan was submitted to the Regional Office during December for approval. Once approved it will be submitted to PG&E biologists for review. Their concurrence will be needed for projects influencing endangered species found on PG&E land. Some of the best populations of endangered plants and Lange's metalmark butterfly are found on PG&E land. The 230KV towers constructed in the early 1920's located on this land protected the riverine dune habitat from sand mining activity.

5. Research and Investigations

A permit was issued to Bruce Pavlik (Mills College) to conduct a reserach project entitled "Seed Biology of the Endemic Plants at Antioch Dunes NWR, California". Objective of the study is to generate management guidelines for the recovery of the Contra Costa wallflower and Antioch Dunes evening primrose based upon the history and ecological characteristics of the species. Specifically, the study will include; 1)measuring seed production as related to plant size and competition from weedy neighbors, 2)estimating the relative importance of pollination, fertilization and pre-dispersal predation in limiting seed production, and 3)studying seed germination responses to temperature, light and soil texture.

E. ADMINISTRATION

3. Other Manpower Programs

Twelve refuge volunteers planted 1000 buckwheat seedlings on the Sardis Unit as part of an attempt to expand Lange's metalmark butterfly habitat in the "pit" area.

Refuge biologist Louise Accurso (foreground) and volunteers spent a windy day planting buckwheat seedlings on the Stamm Unit. Volunteers contributed over 200 hours of field service during 1987 (Munoz).

Fifteen California Conservation Corps members spent two days planting 7000 buckwheat seedlings on the Stamm Unit. These young adults also worked at the State native plant nursery where the buckwheat was grown. Thus they participated from beginning to end in a conservation project and, they could see the future benefit of their work at the nursery.

4. Volunteer Program

Refuge volunteers assisted the complex biologist contributing about 200 hours of field service. Projects included censusing endangered plants, exotic vegetation removal, litter pick-up, and buckwheat planting.

SCA's Belinda Baines, John Moll and Maria Mahar contributed a total of 300 hours at Antioch Dunes. Projects included censusing and monitoring of endangered species, seed collection, litter pick-up, and buckwheat planting. The work at Antioch Dunes is laborious and time consuming and could not be accomplsihed without the help of these hardy volunteers.

8. Other Items

A revenue sharing payment in the amount of $10,065 was presented to Contra Costa County during 1987.

F. HABITAT MANAGEMENT

2. Wetlands

The northern boundary of the refuge, the San Joaquin River, is approximately 2/3 of a mile long and is tidally influenced. The riparian corridor is less than 10 feet wide due to the tall embankment along the river's edge. Like the rest of the refuge, the riparian area is highly altered. Dominant vegetation includes scattered willow, oak and locust trees and small patches of emergent aquatic plants, such as bulrush and cattail.

6. Other Habitats

During May, tractor operator Steve Lewis cleared about eighty percent of the vineyard located on the Stamm Unit. The grape vines were piled in the refuge dump truck and dumped at the Antioch landfill. The purpose of the work was to prepare the site for the 7000 buckwheat seedlings that were planted during December. Just prior to planting, Steve rototilled the old vineyard to reduce competition from weedy species. The buckwheat plants were propogated from seeds collected last year on the refuge. The seeds were germinated and grown to seedling stage by California Conservation Corps personnel at the Napa Nursery site. Volunteers, refuge staff and CCC workers combined forces and planted all the seedlings during December.

The 15 square meter hardpan plot continued to be weeded of exotics and seeded with natives. Other exotic vegetation control involved removing ice plant that invades from adjoining land, hand-pulling Russian thistle and yellow star thistle, and cutting

and removing fennel. The Sardis unit and neighboring PG&E west parcel have stands of Ailanthus and Locust trees which are invading valuable habitat. Many of these trees were cut down in 1984 but resprouted. Talks were held with a PG&E specialist to discuss control options. He recommended spot treatment with "Galvon".

The small sand dune created on the Stamm Unit during 1986 has proved to be very successful. Excess sand was moved and shaped into a small bluff. During December 1986, 450 buckwheat seedlings were planted in 50 round plots of nine plants each. Within one year, the site has developed into what should soon be excellent Lange's metalmark butterfly habitat. Approximately, 70 percent of the seedlings survived and within two years should begin to be colonized by butterfly larval.

Some areas burned by wildfires are reseeded with native and endangered plant seeds collected by refuge staff. These disturbed areas have supported record numbers of endangered plants compared to unburned unseeded areas. The use of excelsion matting on eroded sites on the Sardis Unit (reported in last year's annual narrative) appears to be effective in stopping the erosion caused by foot traffic from the days when this area was opened to the public.

A meeting was held with Domtar Gypsum America, Inc., during October to discuss the problem about gypsum dust blowing onto the Sardis Unit and PG&E land adjacent to the industrial site. Domtar officials were very responsive to our concerns and agreed to pay for 200 feet of windscreen. The windscreen will be fastened to an existing chain link fence separting Domtar and PG&E properties. The windscreen hopefully will act as a "drift fence" and cause gypsum dust to fall out at the fence line rather than blowing onto critical habitat. The windscreen is the same material used around tennis courts to reduce wind.

The vineyard on the Stamm Unit as it looked prior to habitat rehabilitation work for Lange's metalmark butterfly (Refuge file).

Maintenance man Steve Lewis ripped out the grapevines, loaded them in the refuge dump truck and dumped them at the local landfill (Munoz).

The old vineyard site was plowed one week prior to planting of buckwheat seedlings, the host plant for Lange's metalmark butterfly (Accurso).

About half of the vineyard area was planted with buckwheat seedlings. Pictured above, is Project Leader Rick Coleman handing out seedlings to volunteers (Ranoa).

Harsh weather conditions on planting day raised concerns about seedling survival (Munoz).

9. Fire Management

Two wildfires burned on the Stamm Unit during the summer. The first fire burned about 1/4 of an acre of lupine brush dominated land adjacent to the parking lot. A few Antioch Dunes evening primrose plants may have been destroyed. Overall, the effects of this fire should be beneficial as competition from the lupine bush would not allow the endangered plants to become established. Suspected cause of the fire was fireworks. Riverside fire department personnel responded to the fire.

The second fire burned a very small spot along the San Joaquin River where the closed area boundary is located. Suspected cause of this fire was a campfire. The fire burned itself out when it ran into the trail that parallels the river.

PG&E again funded establishment of firebreaks on the Sardis Unit along Wilbur Avenue. The firebreaks were established by mowing 30 foot wide breaks in an area composed primarily of exotic annual grasses and weeds. This project appears to be successful as this represents the second year no wildfires have occurred on the Sardis Unit.

G. WILDLIFE

1. Wildlife Diversity

In addition to the three endangered species the Antioch Dunes area has many other unique flora and fauna. The Antioch Dunes is the type locality for 24 insect taxa; ten of these are endemic, six are known only from other imperiled habitats, and two (with wider ranges in preagricultural times) may now exist only on the refuge. Three species of reptiles reach their northernmost range on the refuge. These reptiles are the glossy snake, side-blotched lizard and the legless lizard. Seventy-eight species of birds and eight mammals have been identified on the refuge since November 1983.

2. Endangered and/or Threatened Species

A. Lange's metalmark butterfly (Apodemia mormo langei)

This insect was first described in 1938 following intensive entomological studies at Antioch Dunes initiated in 1931, and extended through that decade. Additional studies were conducted for a few years following World War II. The butterfly is listed as an endangered species by the Secretary of the Interior in the June 1, 1976 Federal Register. Critical habitat was proposed in the February 2, 1977 Federal Register but did not get finalized.

In 1986 Dr. Richard Arnold's permit to perform capture-recapture studies on the butterfly was not renewed. It was determined through Section 7 consultation that repeated handling of this delicate species may jeopardize its survival and that such studies should be discontinued. Therefore, no estimated number of adults was determined for 1986 and 1987. "Eyeball" counts of butterflies were taken this year by refuge staff and volunteers. This will serve as an index from which we can monitor the butterflies in the future. In 1985 thirty-six butterflies were manually transfered by Arnold between the Sardis colony and Stamm colony of butterflies. No butterflies were transfered between sites in 1986 or 1987. Counts in 1987 indicate the butterfly population is on the rise (table 1). The single day peak for 1987 was 248 compared to 154 during 1986.

TABLE 1. LANGE'S METALMARK BUTTERFLY CENSUS RESULTS, ANTIOCH DUNES NWR, DURING 1987 (1986 results in parenthesis)

Time Period	last wk July	1st wk Aug	2nd wk Aug	3rd wk Aug	4th wk Aug	1st wk Sept
LOCATION						
STAMM UNIT	0	10	14(15)	126(110)	175(116)	112(22)
PG&E west	0	0	1	25	54(35)	32(19)
PG&E east	1	0		5	5(1)	10(0)
Sardis Unit				5	14(2)	11(3)
TOTAL	1	10	15(15)	161(110)	248(154)	165(44)

B. Antioch Dunes evening-primrose (Oenothera deltoides howellii)

This member of the evening-primrose family is an attractive, short-lived perennial with large, white flowers. The Antioch Dunes evening-primrose was listed as an endangered species by the Secretary of the Interior in the April 26, 1978 Federal Register. The entire refuge and some surrounding land were designated as critical habitat in the August 31, 1978 Federal Register.

Once relatively common in the Antioch Dunes area, this plants natural range has been reduced to 60 acres which is the last remaining native habitat for the species. In 1978 the reported total population of this species included 872 flowering plants, 376 small plants with few or no flowers, 184 rosette plants, and and 97 dead plants. No small seedlings were observed. In 1984 a complete survey of the two refuge units found a population of 5132 living plants. No breakdown as to size or flowering history was made. Most (98%) of the evening-primrose were found on the Stamm Unit. In 1985 only a partial survey was done, with five transects taken on the Stamm Unit, and all of the Sardis and PG&E units surveyed. This data will provide baseline information for surveys done every other year, when complete surveys are not done. Although not all of the 15 square meter plot was in a transect, a complete count of the plot was done to monitor its changes. In 1986, 5843 evening-primrose plants were counted. The majority (93%) of the plants were located on the Stamm Unit.

Antioch Dunes evening primrose begin flowering during April. The population of this endangered plant appears to be stable.

Transects conducted during 1987 to document the status of ADEP indicated that the total population size was stable, however, recruitment of new plants appear to be down. This will be further evaluated during 1988, a year in which total counts will be made.

The Antioch Dunes evening-primrose appears to grow only in a pure sand medium. It is not known at this time if the natural limitation may be Delhi soil (sand) which is more widely distributed than the dunes proper. As the Antioch Dunes area became more and more disturbed by human activities, exotic plant species invaded and colonized the disturbed areas. These weedy species stabilize dune slopes preventing the deposition or uncovering of fresh sand necessary for the establishment of evening-primrose seedlings. In addition, mining, agricultural, urban and industrial expansion activities have severly restricted the fresh sand availability. Reduction of the dune habitat probably also has limited the resources necessary to support the pollinators of this plant species.

C. Contra Costa wallflower (Erysimum capitatum angustatum)

This flower is a biennial member of the mustard family. The Contra Costa wallflower was listed as an endangered species by the Secretary of the Interior in the April 26, 1978 Federal Register. Critical habitat was established in the August 31, 1978 Federal Register for the Contra Costa wallflower.

Contra costa wallflower distribution changed so that the largest concentrations of this endangered plant were located on the Stamm Unit (Munoz).

Endemic to the Antioch Dunes, Contra Costa wallflower habitat totaled several hundred acres a few decades ago but is now limited to a few acres. In the spring of 1982, UC Berkeley graduate student Robert Price conducted a number of studies on the wallflower at the refuge to determine the relationship of the Antioch Dunes population to the rest of the E. capitatum complex. Price surveyed flowering wallflowers in early April 1982 and

counted 180 on the Stamm unit and 350 on the combined Sardis and PG&E units. In early May, 1983, Price counted 105 flowering wallflower on the Stamm unit and 647 on the combine Sardis and PG&E units. No attempt was made in 1982 or 1983 to tally first-year rosettes. In 1984 98 wallflowers on the Stamm unit and 720 on the combined Sardis and PG&E units were counted. In 1985 115 flowering wallflowers on the Stamm unit and 671 on the combined Sardis and PG&E units were counted. Table 2 details results of counts made by Louise Accurso during 1986 and 1987. Total plants jumped 697 to 2189. A major shift in the distribution of plants was documented. The greatest concentration of plants was on the Stamm Unit. Reasons for this change are not completely understood, but may be related to the distribance factor caused by wildfire. Major destruction and alteration of habitat by exotic vegetation competition and human activities as described previously are the biggest threat to the survival of this species. More information is needed on the reproductive biology and habitat requirements for this species to define recovery efforts necessary for its conservation.

TABLE 2. CONTRA COSTA WALLFLOWER
CENSUS RESULTS, ANTIOCH DUNES NWR.

YEAR	1984	1985	1986	1987
Stamm Unit	98	115	99	1344
Sardis/PG&E	720	671	1393	810
Domtar Area	31			35
TOTAL	849	786	1492	2189

Abnormal growth forms found on Contra Costa wallflowers on the Sardis Unit was puzzling (Acurso).

10. Other Resident Wildlife

Seven native insect species that are believed to be present on the refuge are candidates for listing under the Endangered Species Act. These insects include the Middlekauf's katydid, Antioch robber fly, Antioch vespid wasp, Antioch tiphiid wasp, Antioch sphecid wasp, yellow-banded andrenid wasp, and the Antioch andrenid bee. All of the insects, except the Middlekauf's katydid which is associated with live oaks, are sand dune inhabitants. Basic life history and distribution studies of these species are needed.

11. Fisheries Resources

Bank fishing along the San Joaquin River is a popular activity and was occurring on the site prior to FWS acquisition. In 1983 a fishing management plan was prepared and approved for Antioch Dunes NWR. As part of the plan, cable fencing was put in by the 1983 YCC crew to close particularly sensitive areas of the Stamm unit. In addition, signs showing the designated fishing areas and the closed/sensitive wildlife areas were posted. Unfortunately, signing and cable fencing have been extensively vandalized and/or stolen and are not keeping people out of the closed areas. In order to decrease the habitat destruction caused by people whether they are fishermen or not, the Sardis unit was closed to the public. This fence eliminated a favorite fishing spot of the local people, but is necessary for the protection of the endangered species within the refuge.

A similar problem was occurring on the Stamm Unit. The parking lot at this site was continually being littered by visitors. It appeared the primary offenders were people using the lot as a beer party site. Since it was becoming harder to maintain the quality of the site both for aesthetic reasons and for preservation of habitat, it was decided to close the parking lot to vehicle access. The lot was closed in October, and, by the end of the year, few complaints have been received about this action.

12. Wildlife Propagation and Stocking

In 1986 Antioch buckwheat was grown in a nursery by the California Conservation Corp from seed collected at the refuge. The buckwheat was planted on the refuge and one PG&E parcel in December between winter rain storms. After one year, it appears about seventy percent of the 1000 sedlings have survived. During 1987, 8000 buckwheat seedlings were planted using the same procedure as described above.

H. PUBLIC USE

2. Outdoor Classrooms - Students

In March an Antioch High School class visited Antioch Dunes NWR refuge for an interpretive walk led by a member of the refuge staff. Although many of these students had grown up in the

Pittsburg/Antioch area, they had never heard of the refuge. Others had been to the site before it was established as a refuge, but had no idea it was acquired as a refuge for endangered species. In April, 15 students from Los Madonos Community College were given an interpretive tour of the Stamm Unit.

9. Fishing

The Stamm unit has approximately 2000 feet of shoreline bordering the San Joaquin River that was still open for fishing during most of 1987. The area has been used by approximately 1200 anglers in 1987. Fish caught are usually channel catfish and striped bass.

16. Other Non-Wildlife Recreation

Part of the Stamm Unit was open for hiking, swimming and picnicking during most of 1987. Approximately 2,500 people were observed participating in one of these activities in 1987.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

The gate to the Sardis Unit was rammed open twice and the chain link fence was cut once this year. Limbs on oak trees near the fence were cut to reduce the amount of cover for vandals. Since trimming the trees no further problems have occurred. Also the center post on the gate was left off and the gate was locked with a chain. This has reduced the damage caused by people ramming the gate with vehicles.

J. OTHER ITEMS

3. Credits

This report was prepared by Dick Munoz who relied on information prepared by Louise Accurso. Typing was accomplished by Kathy Zeliff.

FARALLON NATIONAL WILDLIFE REFUGE

San Francisco County, California

ANNUAL NARRATIVE REPORT

Calendar Year 1987

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Farallon National Wildlife Refuge was established in 1909 and is located approximately 28 miles west of San Francisco. It is comprised of four groups of islands including the North Farallons, Middle Farallons, and Noonday Rock which are all designated as wilderness areas. The South Farallons Islands were given refuge status in 1969 and is the largest group consisting of 120 acres and reaching a height of 370 feet. The refuge totals 211 acres.

The refuge comprises the largest continental seabird breeding colony south of Alaska. It supports 12 nesting species including the largest breeding colonies of ashy storm-petrel, Brandt's cormorant, and western gull in the world. The islands also support five pinniped species. After an absence of over 100 years, northern elephant seals returned in 1959 and now breed on the South Farallon Islands.

The Farallons are a granitic formation that is part of the Farallon Ridge. Shallow soils can be found scattered on some of the South Farallons. Vegetation is dominated by Farallon weed, an important nest building material for cormorants and gulls. Floral diversity is limited and is made up of a high proportion and number of nonnative species due to the large amount of human activity on the Southeast Farallons since the 1800's.

Wildlife populations were heavily exploited in the late 18th and 19th centuries for meat, hides, and eggs. Over-fishing of sardines reduced seabird food supplies. Some species were extirpated while others declined drastically. Historical estimates indicate that thousands of northern fur seals and as many as 400,000 common murres once populated the islands. An active Coast Guard station further impacted island wildlife and habitat until the full automation of the light station in 1972. While some species have recolonized the islands, others are slowly recovering. Wildlife remain vulnerable to the impacts of pollution, oil spills, and gill net fisheries. The Service has cooperative agreements with Point Reyes Bird Observatory and the U. S. Coast Guard to facilitate protection and management of the refuge.

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K. FEEDBACK

A. HIGHLIGHTS

It was an excellent breeding season for many seabirds, following an extremely poor season in 1986. However, common murre populations continued to decline (G.5).

Gill net fishing mortality of common murres and other seabirds was halted in central California with the passage of more restrictive regulations. Cooperative aerial surveys (by the refuge and Point Reyes Bird Observatory), which documented severe murre population decline, helped to catalyze this solution (D.5 and G.5).

Northern elephant seal pup survival was high, due to a mild winter with no major storms (G.9).

Two major maintenance projects were accomplished! The reroofing of the house and cistern (I.2).

B. CLIMATIC CONDITIONS

Temperatures are relatively constant throughout the year, seldom falling below 40 F or rising above 60 F. Most rainfall occurs in the winter. Summer moisture is usually limited to damp fog. Offshore fog banks frequently envelop the islands in dense fog.

The winter was unusally mild and dry. No major winter storms occurred. Northwest winds which produce ocean upwelling began in February and were consistent during the latter half of March (G.5).

D. PLANNING

5. Research and Investigations

Farallon NWR is managed by the Fish and Wildlife Service out of the refuge complex headquarters. We hold a cooperative agreement with the Point Reyes Bird Observatory (PRBO) for their biologists to be present on the island year-round. They provide day-to-day resource protection, routine maintenance, and also conduct or monitor research approved by the Service. The refuge provides funding, maintenance support, and direction and some support for studies.

PRBO studies were numerous, some of which are long term projects that hve been ongoing since the 1970's. They included:

Population demography of the western gull: This study examined breeding biology, effects of senescence and quality of mate on reproductive success, and reproductive life span. Monitoring known-age gulls provides the core of this project.

Density-dependent effects on the population demography of northern elephant seals: Determining carrying capacity and the importance of density-dependent effects on population regulation are objectives of this long term project.

Reproductive ecology of the northern elephant seal: Multiple objectives focus on the effects of age on reproductive success and the implications of a changing age structure. Methods included tagging, marking (with dye or bleach), and censusing elephant seals during the winter breeding season (G.9). Studies have been conducted annually since the Farallons were recolonized by seals in 1972. Because the population is small and a pool of known-age seals has developed over many years, a unique opportunity for long-term population studies exists.

Population structure of Cassin's auklets on Southeast Farallon Island: Data collected for this study are being analyzed and prepared for publication.

The relationship of age to breeding effort and success in Brandt's cormorants: The colony at the Farallons represents the largest single Brandt's cormorant colony in the world. Life-history parameters are being investigated such as age of maturity, fecundity, longevity, mate/site fidelity, survival to breeding age, and how these relate to breeding effort and success. Their relationship to annual ocean conditions are also being examined. Methods included monitoring reproductive success of known-age birds, including several that were hatched in the early to mid-1970's.

Population decline of the common murre in central California: Refuge and PRBO biologists cooperated to conduct aerial surveys of the North and South Farallon Island murre colonies in 1985 and 1986 (G.5). Eleven other murre colonies were surveyed in central and northern California, including Castle Rock NWR near Crescent City. Objectives were to determine an accurate estimate of Farallon murre populations and to determine the status of other California colonies. The central California population (8 colonies) declined 52.6% over 4-6 years, from 229,080 in 1980-1982 to 108,530 in 1986. The northern California breeding population remained relatively stable during the same period. Population declines in central California were caused by high murre mortality from an intensive gill-net fishery, compounded by mortality from oil spills and the 1982-1983 El Nino-Southern Oscillation event. Results were presented by Jean Takekawa at the Pacific Seabird Group meeting in December.

Common murre population estimates were further refined with a ground truthing correction factor, determined by counts in plots visible from the ground and in aerial photographs.

Population size and diet of Farallon storm-petrels: Ashy storm-petrel populations were last estimated at approximately 4,000 in 1972-73. Other studies have indicated that approximately 77% of the world population nests on the Farallons. Objectives of this study were to estimate breeding populations of ashy and Leach's storm-petrels, and describe and quantify their diets. Methods included mark-recapture of birds using mist nets and collection of regurgitations for diet analyses. Several hundred storm-petrels had been captured by early fall. Results will be available in 1988.

Population size and diet of rhinocerous auklets: A dramatic increase in rhinocerous auklet numbers was first observed in 1986 and continued in 1987 (G.5). The objectives of this study were to more accurately determine population size and describe and quantify diet. Methods included mark-recapture of birds using mist nets at the entrance to breeding burrows at several sites, and collection and identification of food items carried in by netted birds. This pilot study will be continued in 1988.

Migration, dispersal, and survivorship of coastal central California land birds: Landbirds were monitored daily and most intensively during spring and fall migration (Section G. 7). Objectives are to investigate factors responsible for relative abundance, numbers and timing of various species, and describe relationship between weather and timing and intensity of migration.

Independent researchers also conducted studies on the refuge. They included:

Effects of human disturbance on brown pelicans: Deborah Jaques, U.C. Davis, conducted a study on boat and other human disturbance to pelican roosts for her Master's thesis. The Farallons was used as a control site. Her results will be written up in 1988.

Brandt's cormorant colony development and breeding behavior: Jack Feldman, San Francisco State University, conducted his Master's project on the Farallons in 1986. He examined breeding chronology and correlated his data with known-age data available from PRBO. He presented preliminary results at the Pacific Seabird Group meeting in December.

Bioaccumulation of long-lived radionuclides by marine organisms from the Farallon Islands nuclear waste dump site: Intertidal mussels (Mytilus californianus) were collected from Southeast Farallon Island by Thomas Suchanek, Bodega Marine Laboratory (U.C., Davis). Objectives were to determine radionuclide levels in marine invertebrates and fish near the dump site. An estimated 47,500 containers (mostly 55 gallon drums) of radioactive waste were dumped there. Previous analyses of mussels from the Farallons have produced elevated levels of 239,240-Plutonium and 241-Americum. Mussels were collected twice in 1987. Results are pending.

Survey of the insects of Southeast Farallon Island: John Steiner, Park Ranger on the refuge staff, conducted an independent study on intertidal and soil insects. No comprehensive survey of insects had ever been done. He captured and preserved insects using light traps, nets, and funnel traps. He investigated various habitats including caves during the fall. He will conclude his collections in spring 1988.

E. ADMINISTRATION

4. Volunteer Program

During the calendar year 1987, approximately 111 volunteers donated almost 23,000 hours of service at the Point Reyes Bird Observatory research station on Southeast Farallon Island. Volunteers assumed a variety of responsibilities including assisting with marine bird and mammal research, censusing, collecting meteorological and oceanographic data and performing tasks related to facility and equipment maintenance and construction.

5. Funding

The Point Reyes Bird Observatory continued to receive the equivalent of a GS-5 and GS-7 salary from the Service. Budgetary restrictions precluded any increases in FY88. Special ARMMS

funds were obtained for the reroofing of the house and cistern (fresh water reservoir) in the amount of $33,844(I.2).

6. Safety

Fresh water is provided by the Coast Guard, which delivers water in their cutter, the BLACKHAW, 3-4 times each year. Water is stored in the cistern, which was reroofed in 1987 (I.2). Winter rains resulted in seepage into the cistern through an unknown route. Water levels increased during winter rains, and an algal bloom and extremely high turbidity resulted. Water was tested at a laboratory on the mainland and yielded high levels of E. coli. Until an improved filtering system could be developed, tap water was not consumed without boiling on the refuge.

7. Technical Assistance

Refuge staff participated in a research planning meeting with the National Marine Sanctuary staff, which oversees the Gulf of the Farallones National Marine Sanctuary.

F. HABITAT MANAGEMENT

1. General

The refuge consists of 211 acres of mostly rocky and marine habitats. In addition, the Southeast Farallon Island (SEFI), where all facilities and PRBO staff are located, supports a soil-covered marine terrace. Island flora includes 45-50 species. Rocky habitats provide nesting areas to many seabird species including common murres and Brandt's cormorants. Soils provide habitat to burrow-nesting species like Cassin's auklets. Most rocky and marine habitats are largely undisturbed. However, habitats which can support plant life on SEFI have been significantly impacted by a history of human occupation and disturbance. Many exotic plant species such as weeping grass (Bromus diandrus) flourish on the island and in some areas, have displaced the native Farallon weed (Lasthenia minor).

3. Forests

The "woodland habitat" on SEFI consists of several transplanted Monterey cypress and one low-growing Monterey pine which are able to tolerate the strong prevailing winds. These small trees, together with the remains of two larger cypress which toppled over during the storms of November 1981, serve as veritable magnets to migrant landbirds. During the spring and fall, large numbers of vagrants can be found in and around these trees, thus facilitating trapping and censusing of these birds.

10. Pest Control

FWS and PRBO biologists and volunteers continued to remove exotic vegetation by hand to prevent encroachment across the marine terrace and up Lighthouse Hill. Species controlled included broccoli (*Brassica oleracea*), ice plant (*Mesembryanthemum chilense*), New Zealand spinach (*Tetragonia tetragonoides*), and *Lavatera arborea*. In September, refuge staff tested the use of the herbicide Round-up to control New Zealand spinach. This low-growing exotic has gradually spread across the lowerflanks of Lighthouse Hill. Results were monitored through the year. Plants initially wilted and some were killed by the herbicide but many had begun to recover by the end of the year. Mechanical control will be continued in future.

12. Wilderness and Special Areas

In 1973, Middle Farallon Island, North Farallon, and Noonday Rock were designated a National Wilderness Area. The largest island, Southeast Farallon, was excluded from this designation because of the structures and people living on the island. The islands within the wilderness area serve as marine bird and mammal breeding areas. These islands are not accessible to humans due to rough seas and rocky cliffs. Periodic aerial surveillance is the only management practiced on these islands, therefore the wilderness designation does not affect Refuge operations.

Lush Farallon weed covers the marine terrace on the Southeast Farallons. In the background is the more inaccessible West End Island, a National Wilderness Area (G.9).

G. WILDLIFE

2. Endangered and/or Threatened Species

a. American Peregrine Falcon

The first peregrine of the fall/winter season was sighted on 27 August. Peregrine use peaked at 4 individuals in December. Use days dropped from 543 in 1986 to 450 in 1987. Cassin's auklets were a primary food source on SEFI based on numerous carcasses found at feeding sites. Four pigeon guillemot carcasses were also found that had been fed on by peregrines. In October, a peregrine of the Falcon peregrinus tundrius subspecies was confirmed on the refuge, which was the third or fourth island occurrence of this subspecies.

b. California Brown Pelican

Brown pelican numbers peaked at higher levels in 1987 than in 1986, at 3,400 in November (table 1). However, overall numbers and use days were similar to 1986, making 1987 the third consecutive year that brown pelican numbers were low. Pelican use is concentrated in the fall and winter months when birds commonly roost on the islands. Year to year fluctuations in numbers are probably related to the relative abundance of food resources in coastal and offshore zones.

In December, two sick pelicans were recovered. A die-off was reported in the Monterey Bay area, but it was not known whether these incidents were related.

Table 1. Peak monthly population estimates of California brown pelicans on SEFI with total annual use-days shown at the bottom.

Month	1983	1984	1985	1986	1987
January	12	0	2	2	0
February	0	118	0	0	0
March	3	221	1	18	1
April	11	34	1	3	6
May	90	3	38	122	68
June	240	10	405	150	250
July	870	190	592	50	800
August	2440	1000	1300	200	1144
September	1650	5670	2257	1850	1160
October	1650	2647	2700	1065	3400
November	1090	2583	543	1000	1035
December	100	55	66	100	200
Total Use-Days	117,507	166,414	88,837	84,873	84,047

3. Waterfowl

In October, the first observation of a ring-necked duck was recorded.

4. Marsh and Water Birds

A great blue heron was observed dead on the refuge. This may have been the bird that set up residence for much of 1986, feeding among the tide pools and along the marine terrace. A black-crowned night heron and a Virginia rail visited the island in August, a fifth island record for both. The fourth island record of a Clark's grebe was recorded in October.

5. Shorebirds, Gulls, Terns and Allied Species

Farallon NWR is an extremely important breeding site for seabirds. It supports 35% of the breeding seabird population in California and is the single largest seabird colony in the contiguous United States. Large segments of the state's breeding seabird populations use these islands for nesting including ashy storm-petrels, Brandt's cormorants, western gulls, tufted puffins, rhinoceros auklets, and Cassin's auklets.

Seabird populations and productivity were monitored by PRBO by cooperative agreement. Following an extremely poor breeding season for seabirds in 1986, 1987 was an average to excellent year for almost all species. Populations were relatively stable for western gull, black oystercatcher, pigeon guillemot, and tufted puffin, and increased for all three cormorant species and rhinoceros auklets. Rhinoceros auklet population increases reflected a continuing range expansion southward, as well as recruitment. Numbers were estimated at 600 birds, including 500 breeding birds. Increases in cormorant numbers may reflect recovery from gill netting and the 1982-83 El Nino. The common murre population, however, continued to decline in 1987. Cooperative aerial surveys (FWS and PRBO) had previousy shown that North and South Farallon Island populations declined 55.6% and 46.8%, respectively, from 1982 to 1986 (D.5). Declines were largely due to the high mortality caused by the gill net fishery and the lag effects of reduced recruitment in the early 1980's.

The California Department of Fish and Game estimated that from 1982-86, approximately 65,000-70,000 murres were killed in gill nets in central California. Refuge staff assisted in a cooperative effort to reevaluate gill net fishing regulations, in order to develop a long-term solution to the high seabird and marine mammal mortality associated with this fishery. In mid-March of 1987, refuge staff participated in at-sea surveys of murres with PRBO, at the request of CDFG, to determine whether the location of murres warranted emergency closures for gill netting. Based on nearshore locations of murres, emergency closures were extended. Cooperative survey results (FWS and PRBO) were made available in early 1987, which indicated that all central California murre colonies had suffered severe declines, and colonies nearest to heavy fishing pressure had declined the most. Individual colonies had declined by 45.6-100% in 4-6 years. These results provided strong evidence that the Farallon and other murre colonies could sustain no further mortality and that the existence of some small colonies was threatened. In September 1987, a state legislative bill was passed with much stronger regulations, which virtually eliminaed the nearshore gill net fisheries. Seventeen murre colonies (including the Farallon Islands) were aerially surveyed in 1987, however, photographs were not processed.

The western gull population remained relatively stable and gull predation on murre eggs and chicks was down, probably due to high ocean productivity and food availability.

Seabird breeding activities on the Farallon Islands are correlated with the seasonal occurrence of oceanic upwelling off central California. Extended periods of strong northwesterly winds during late winter and early spring promote the upwelling of cold, nutrient-rich subsurface waters which in turn stimulate phytoplankton blooms and the production of zooplankton and juvenile rockfish, which are the prey-base for the seabirds of the Refuge.

A summary of breeding populations and reproductive success is presented in Table 2. The abundance of juvenile rockfish close to the Farallons helped to make 1987 an excellent year for many breeding seabirds, following a year of extremely poor production in 1986. The first common murre egg was laid on 28 April, 10 days earlier than in 1986. Murre chick diet was made up of over 90% juvenile rockfish. This was an average breeding year for Brandt's cormorants, western gulls, and Cassin's auklets, but was an excellent breeding season for pelagic cormorants, common murres, and pigeon guillemots. This followed a year of almost complete reproductive failure for pelagic cormorants and pigeon guillemots in 1986. Over 50% of the Cassin's auklets pairs that successfully fledged a chick in their first attempt, laid a second egg. However, most such attempts were unsuccessful.

Pelagic cormorants experienced high reproduction in 1987, after almost complete reproductive failure in 1986.

TABLE 2

Southeast Farallon Breeding Seabird Populations

	1985		1986		1987	
SPECIES(1)	BP*	YF*	BP	YF	BP	YF
Ashy storm-petrel(2)	4000	1440	6000	2730	4000	
Double-crested cormorant	322		240		350	1,840
Brandt's cormorant(2)	8310	10,390	6372	4237	10,266	9,239
Pelagic cormorant	922	1110	664	33	760	950
Black oystercatcher	34	17	40	32	40	7
Western gull(2)	27,640	22,530	28,788	18,568	21,864	10,230
Pigeon guillemot	1300	810	1250	13	1100	770
Common murre	36,950	14,595	39,360	14,957	34,400	15,480
Cassin's auklet	105,000	39,375	105,000	38,325	135,000	47,250

* BP=Breeding population; YF=Number of young fledged

(1) Data for Leach's storm-petrel, tufted puffin, and rhinoceros auklet are not available, due to small population sizes and inaccessibility.

(2) Farallon National Wildlife Refuge contains the largest breeding colony in the world for these species.

On 15-16 August, a rufous-necked stint was recorded at the island for the first time. This was the first juvenile rufous-necked stint ever confirmed in California. Other unusual observations of note included: the second island record of a flesh-footed shearwater, the fourth island record of a buff-breasted sandpiper, and the sixth and seventh records for a South Polar skua.

6. Raptors

Small numbers of burrowing owls (1-4) were seen in most months, except for June-August. American kestrel numbers peaked at four in September, but they were absent for several months (January-July). The sixth barn owl on record was observed in September. Other species which were seen during the fall included sharp-shinned hawk, northern harrier, merlin, long-eared and short-eared owl, and northern saw-whet owl.

7. Other Migratory Birds

Southeast Farallon Island is a place well known among ornithologists, ecologists, bird watchers and others, for the number and diversity of land and freshwater birds that show up on the island. Many of these birds are common western birds migrating either north or south depending on the time of year, while others are common western birds that are not strongly migratory (e.g. northern mockingbird, western meadowlark). The birds that attract the most attention are the eastern vagrants common elsewhere in the country but not normally found on the west coast or in California. On rare occasions, birds from other continents appear on the island such as red-footed booby, dotterel, dusky warbler and brown shrike.

In the case of eastern vagrant birds, the majority of them appearing on the island are juvenile young-of-the-year birds. Point Reyes Bird Observatory biologists are currently theorizing that these birds were born with physical or chemical defects causing them to incorrectly migrate east to west rather than north to south. If this is true, the intense banding effort will not directly aid in shedding light on this theory since the birds would be flying further out to sea and dying after departing the island.

Landbird visitation to SEFI included some notable species: In October, two dusky warblers became the second and third North

American record (excluding Alaska) for this species; the first island record of a western bluebird also occurred in this month; in September a black-billed cuckoo produced the second island record for this species; and the fourth island record of a pine warbler was reported in November. A pair of rock wrens successfully nested, fledging four young in May. This species had not nested on the Farallons for many years.

9. Marine Mammals

Maximum populations and breeding success for the five pinniped species utilizing Southeast Farallon Island during the last six years are shown in Table 3.

Table 3

MAXIMUM POPULATION NUMBERS (PEAK MONTH)

	1982	1983	1984	1985	1986	1987
California Sea Lion	3435 (Sept)	5570 (July)	6783 (July)	4187 (Apr)	2478 (Mar)	2664 (May)
Steller Sea Lion	192 (June)	141 (June)	208 (Dec)	291 (Nov)	219 (Nov)	191 (June)
Harbor Seal	78 (July)	76 (Aug)	62 (Feb)	55 (Nov)	75 (Nov)	64 (July)
No. Elephant Seal	933 (Apr)	1025 (Apr)	824 (Jan)	763 (Jan)	810 (Jan	845 (April)
No. Fur Seal	3 (Sept)	3 (July)	1 (Oct)	2 (Apr)	8 (Sept)	3 (Sept)

NUMBER OF PUPS BORN/NUMBER OF PUPS WEANED

	1982	1983	1984	1985	1986	1987
California Sea Lion	2/2	3/2	1/1	0/0	0/0	0/0
Steller Sea Lion	12/3	14/1	8/6	5/4	4/2	7/5
No. Elephant Seal	367/257	475/309	437/302	435/279	430/278	NA/260
No. Fur Seal	Historic Breeder - No Recent Records					

California sea lion numbers peaked at very low numbers for the second consecutive year. The majority of these animals consisted of immature individuals. Along the California coast, the majority of California sea lion young are produced south of Point Conception with the Farallons representing the northern breeding limit for this species. As in 1986, no pups were produced this year.

In contrast to the California sea lion, the Farallons are near the southern breeding limit of the Steller sea lion, which pups as far south as southern California. Breeding colonies of this species at the Farallons and further south have all been declining. Production and reproductive success were higher in 1987 than in 1986, with five pups weaned. (Of seven pups born, two were stillborn.) However, populations peaked at 191, the lowest level since 1983.

Stellar's sea lion's exhibit a relatively rare aggressive interaction. On far right is one of five pups that were weaned in 1987.

It is estimated that over 400,000 northern fur seals used the Farallons during the breeding season prior to the arrival of east coast and Russian sealers in the 1800's. This species was subsequently extirpated from the Farallons and today, northern fur seal use only occurs at very low levels and does not include any breeding. Numbers peaked at 3 in September 1987, including one female and two males. This species may someday return as a breeding species since many animals occur nearby at the 100 fathom curve.

Elephant seals were also eliminated from the Farallons, but recolonized the island in the early 1970's. They have been breeding here for over 15 years. More recently, major breeding activity has shifted from the Sand Flat on Southeast Farallon to the larger Shell Beach on West End. Over 60% of the pups were weaned on Shell Beach this year. Many younger females have moved to West End while Sand Flat females were older, age 7-16 years. There were approximately 400 breeding females present in 1987 and aproximately 260 pups were weaned. Survival of pups was high (85%), largely due to the absence of major winter storms. For example, nine pups were produced at two sites (North Landing and Garbage Gulch) where typically, few pups if any are weaned due to storm events which wash them out to sea.

As the breeding population continued to shift to West End Island, human activity increased in order to maintain research and monitoring efforts. However, this Wilderness Area was intended to provide an undisturbed haven for wildlife at the South Farallon Islands. Increased visitation resulted in regular flushing of common murres which attended the island throughout much of the winter. While all activities were conducted with as little disturbance as possible, impact on elephant seals and habitat also increased. Refuge staff developed stricter protocols with PRBO staff to limit numbers of visits and people to that part of the refuge. Continued human activities on West End Island will be reevaluated after the 1988 elephant seal season.

Elephant seals are tagged with two numbered pink plastic tags on the hind flippers. These animals can then be identified on the Refuge and at other sites in California. Farallon-born elephant seals have been observed at haulouts on San Nicholas Island, San Miguel Island, Ano Nuevo and Castle Rock NWR in California and in 1985 for the first time, a Farallon-born yearling was observed on Isla San Martin, Baja Mexico.

Elephant seals hauled out with the much smaller California sea lions at North Landing. (Note the pink-tagged elephant seal in the left center.)

Pinnipeds with neck constrictions were occasionally seen. Materials involved included packing straps and monofilament from gill nets. Constrictions were removed using the "Depkin destrapper" whenever the animal was accessible.

Gray whales were commonly observed migrating during winter months. Numbers were lower than average, but in January whales were seen every day and peaked at 35. Blue whale sightings have increased during the mid-1980's. In August, a peak of 6-10 was observed. Small numbers of humpback whales were reported in most months of the year. Other species observed included minke whale, fin whale, Risso's and Dall's dolphins.

11. Fisheries Resources

Great white sharks were once considered very rare along the California coastline, however, in the 1980's shark sightings, captures by commercial fishermen, and shark bites to humans have all increased. The main reason for the apparent great white population increase is the tremendous increase in their prey base: elephant seals and sea lions. The commonplace occurrence of great whites around the Farallons has virtually eliminated the once popular sport of scuba diving. Commercial abalone diving has also decreased tremendously in response to these predators.

In 1982 a local commercial fisherman captured and killed 4 great whites in one day near SEFI. Subsequently, very few observations of feeding sharks were made in all of 1983 strongly suggesting that the sharks killed had made up a local population in the vicinity of the Refuge. During 1984 an increasing number of "feeding events" were witnessed thus leading us to believe that the local population theory is correct and that the population around the Refuge is increasing. This trend has continued. A PRBO volunteer conducted daily shark watches and observed 11 shark attacks during a two week period in November.

The incidence of commercial abalone divers increased in 1987, as did associated wildlife disturbance incidents. On several occasions, the close proximity of divers disturbed pinnipeds or seabirds on the refuge.

16. Marking and Banding

Banding and color marking seabirds, land birds and elephant seals are conducted on a large scale by Point Reyes Bird Observatory. Since 1971, western gulls, and all three species of cormorants have been banded with Service and color bands. Many of the color bands are numbered or lettered, therefore, some birds have been followed as nestlings through 15 years of life. Valuable information is being obtained in the breeding success of young and old birds, and in relation to adverse environmental conditions and other factors.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

The U.S. Fish and Wildlife Service house was reroofed under contract No. 14-16-001-87089 (TA) by TJ's Roofing of Milwaukie, Oregon.

All existing redwood shingles were removed down to base sheathing. The new roof consists of a 30 lb. felt underlayment covered by a Johns-Manville 25 year composition shingle. Each shingle was applied with six nails and additional adhesive. The roof seems to be holding up well, however a few shingles did blow off during high winds. Apparently the shingles had not sealed well enough before being subjected to 50 knot winds from a storm soon after installation. The damage has been repaired.

The cistern was also reroofed under the above mentioned contract.

All existing compositition roll roofing and 1/2 inch plywood sheathing were removed down to structural joists. Fifty percent of the horizontal 2"x 6" support joists were replaced with new wood. The center four main vertical 6"x 6" support beams were replaced with new wood. The new roof consists of 3/4" plywood sheathing covered by base material and a single ply modified asphalt granulated roll roofing. Modified asphalt is a torch

applied material.

A plastic liner was installed in the emergency water tank. The tank had been unusable for some time due to major leaking. The liner was installed when other attempts to seal the tank had failed. The 10'x13' tank holds approximately 10,000 gallons and is used as a gravitational back-up to the demand system.

The kitchen cabinets were painted.

3. Major Maintenance

A persistent problem of drawing too much power on the generator was solved. It was discovered that the water heater was improperly wired and was not being turned off as thought in order to run the dryer. The water heater was rewired on an isolated circuit.

The ultra violet bulbs were replaced in the water sterilization unit.

Point Reyes Bird Observatory personnel continue to perform minor maintenance and repairs to the islands' building and facilities in cooperation with the Fish & Wildlife Service.

4. Equipment Utilization and Replacement

Lister generator #2 which was installed on 12 July 1986 ran continuously during FY87. This has been a very reliable unit and our major electrical problems o FY86 seem to have been corrected.

The East Landing boom which is utilized in hoisting personnel and cargo on and off the island became inoperable in July '87 when the cable snapped. The cable snapped during a test operation and no one was hurt. New cable and rigging were applied by FWS personnel in August '87 and the boom remained operational as of this writing.

5. Communications Systems

Communications to and from the island are via radio or through a marine operator. Radio equipment utilized by PRBO personnel is the property of PRBO. FWS personnel carry hand held Motorola radios for contact with the base station in Fremont.

7. Other

The U.S. Coast Guard was very busy on S.E. Farallon Island during FY87. Major rehabilitation efforts were focused on the light structure. The Coast Guard Quarters, the fuel system, and the removal of excess materials. The following is a list of some of their accomplishment.

Light Structure
Repaired walkways and all railings, replaced roof, replaced all ladders, sandblast exterior and repainted, repaired exterior masonry, replaced vent screens, installed shelves, serviced Halon fire system, repaired lighting, and installed heater.

Coast Guard Quarters
Preventive maintenance on electrical and plumbing systems, repaired water damaged drywall, replaced broken windows, painted exterior.

Fuel System
Removed 5,000 gallon fuel tanks (one at a time) from Island for repairs on mainland, renewed all suction lines and preventive maintenance on supply lines.

Excess Material
Removed excess paint from paint locker (aprox. 200 gallons) and removed several hundred pound of misc. waste material from various locations on the island.

J. OTHER ITEMS

3. Credits

Steve Lewis wrote Section I and the remainder was written by Jean Takekawa.

ELLICOTT SLOUGH NATIONAL WILDLIFE REFUGE

Santa Cruz County

ANNUAL NARRATIVE REPORT

Calendar Year 1987

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Ellicott Slough National Wildlife Refuge was established in 1975 for the protection of the endangered Santa Cruz long-toed salamander. Of the six known locations where this species can still be found, the refuge supports the largest remaining population. Management objectives are to protect the site from human disturbance and maintain habitat quality.

The refuge consists of 128 acres of upland oak woodland and willow thickets. It is located in Santa Cruz County, 1/2 mile inland from Monterey Bay and four miles west of Watsonville on San Ardreas Road. Combined with the adjacent 30 acres of State land, the area is managed in cooperation with the California Department of Fish and Game. The salamander breeds in the vernal pool on state land in the winter and spends the remainder of the year in the valley and hillside habitat on Service land. These lands were acquired to protect them from a proposed trailer park development.

Ellicott Slough National Wildlife Refuge is closed to the public in order to protect salamander habitat from disturbance.

The Santa Cruz long-toed salamander grows to about five inches in length and has relatively long, tapered toes. It is shiny black, with an irregular pattern of metallic orange to yellow gold blotches along the back. Adults spend most of their life under leaf litter or in animal burrows feeding on beetles, centipedes, earthworms, isopodes and spiders.

Eggs are deposited in the vernal pool during the rainy season. They hatch in one week and develop into adults in about three months. Metamorphosis occurs after larval reach one and one-quarter inches in length. As the vernal pool dries salamanders migrate back to nearby woodlands.

INTRODUCTION

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K. FEEDBACK

A. HIGHLIGHTS

--Plans to spray pampas grass with herbicide were postponed due to administrative problems (Section F.10).

--Research indicates that limb deformities detected on Santa Cruz long-toed salamanders are caused by parasites (Section D.5).

--The vernal breeding pond on adjacent State land did not hold enough water to support development of young salamanders during 1987 (Section F.2).

D. PLANNING

2. Management Plan

A meeting was held at Ellicott Slough with Dan Reno of California Fish and Game to discuss management needs for the year. Most needs centered on the spraying of pampas grass as discussed in Section F.10.

5. Research and Investigations

Steven Ruth reported on research involving the development of deformed limbs among Ellicott Slough salamanders. Colaboration with a parasitologist, identified that the cause of the deformaties was a parasite that forms a cyst in the limb buds. This splits the bud causing growth of multiple, deformed limbs. The vector for the parasite in question has not been determined. Once identified, the vector could be controlled to stop the cycle of infestation.

E. ADMINISTRATION

1. Personnel

Ellicott Slough is administered as a subunit of San Francisco Bay National Wildlife Refuge Complex. As such, no personnel are stationed full time at this site.

8. Other Items

A revenue sharing payment in the amount of $9928.00 was made to Santa Cruz County during 1987. This payment represented 59% of the calculated amount of the 1986 revenue sharing payment as authorized by the Revenue Sharing Act, Public Law 95-469.

F. HABITAT MANAGEMENT

2. Wetlands

The breeding pond for the endangered salamanders is located off of the refuge on State lands, however, a small seasonal stream runs through the refuge into the pond. This stream is typical for this part of California with the riparian habitat consisting mostly of willow trees.

The winter of 1986-87 was dry and the vernal pool never did hold enough water for salamander breeding to occur. The effects of losing one year of offspring is unknown. A yearly census is not currently being conducted, but would be very beneficial to document the effects of such things as drought on the salamanders.

3. Forests

Oak woodland, willow thickets and eucalyptus groves add diversity to this small refuge, occurring mostly on the damp hilly areas. The woodlands are used heavily by passerine birds during migration, since the area is only one mile from the Pacific Ocean.

10. Pest Control

As is true with much of California, the refuge contains many species of plants that historically are not native to the State or country. Pampas grass (Cortaderia selloana), and eucalyptus trees (Eucalyptus sp.) are two of the predominant non-native plants occurring on the refuge. Since acquisition of the area, biologists have been concerned with the spread of these two plants. It is felt that conversion of the native habitat by these two pest species may be detrimental to the salamander population and therefore should be removed. Hand removal of pampas grass was attempted on the southwest facing slope in 1979, however, one year later the pampas grass was back in a dense stand.

In 1982 an internal Section 7 Evaluation and Consultation was completed concerning the removal of these two plants with chemicals. In 1985 many eucalyptus trees were cut down and the stumps treated with Roundup under a special use permit. Approximately 3 acres were cleared of all but the very largest trees. It was planned that additional trees would be treated in

the coming years. A few of the larger eucalyptus trees would be left on the refuge to serve as passerine bird habitat and raptor perches. Unfortunately many of the cut and treated eucalyptus trees resprouted in 1986. Therefore, no trees were treated with Roundup, and another method of control is being researched. During 1987 no additiional work was accomplished on eucalyptus trees.

A cooperative agreement was arranged with the California Department of Fish and Game to spray pampus grass on the refuge. Ten thousand dollars was transferred to the Fish and Game who, in turn, was responsible for arranging a contractor to spray "Round-up" on the refuge. Unfortunately, the contractor arranged for the job backed out and no spraying as accomplished. Plans are being made to accomplish this project with the refuge staff.

G. WILDLIFE

1. Wildlife Diversity

The refuge provides habitat to various migratory birds, as well as resident birds, small mammals and deer. Excluding the presence of the Santa Cruz long-toed salamander, the habitat of the refuge is not unique for this part of California. However, the refuge is located in an intense area of farming in Santa Cruz County. Many of the surrounding valleys and hillsides are used for greenhouses, farmed for strawberries and raspberries, or grazed for cattle. As more areas are converted to agriculture in the future, the refuge will increase in importance by retaining natural habitat for many species.

2. Endangered Species

The proposal by the recovery team to downlist the endangered Santa Cruz long-toed salamander to threatened status did not occur in 1987. This proposal is still being pursued, however. The reason for down-listing is due to the two major breeding sites (Ellicott Slough and Valencia Lagoon) being protected by Federal and State ownership. Also, four additional breeding sites for this species have been located. Dr. Steven Ruth, of Monterey Community College, feels that if one more breeding site can be identified then downlisting can proceed.

Santa Cruz long-toed salamanders are rarely seen because they spend most of their time under leaf litter or in animal burrows.

Ruth was consulted to determine what projects should be undertaken on the refuge to enhance the salamander. His suggestions included: a) Removing eucalyptus trees and replacing with coastal live oak seedlings, b) Spraying pampas grass with "Round-up" to further enhance terrestrial habitat of the salamander, c) Excavating about one foot of material from the center of the breeding pond to increase water holding capabilities, d) Creating a new breeding pond on FWS land south of the entrance road, e) Modifying culverts under San Andreas Road so that they serve as migration corridors for salamanders found west of this county road, f) Rehabilitating the stock pond used by tiger salamanders on the south portion of FWS land, g) Determining land ownership of the permanent pond near the east boundary of the refuge, and, h) Implementing a yearly census of salamanaders that indicates relative health of the Ellicott Slough population.

H. PUBLIC USE

7. Other Interpretive Programs

A tour of the refuge was given to refuge volunteers and SCA's. Because the refuge is closed to the public and difficult to locate, many people are unaware of its existence.

17. Law Enforcement

Public Safety officers and biological staff visit the area several times a year. No regular patrol schedule was maintained during the year.

Problems with dumping of trash and abandoned vehicles were dealt with in cooperation with the California Department of Fish and Game. The problem is primary on fish and game land at the gate leading into the vernal pond. Refuge personnel drove the refuge dump truck to Ellicott Slough and assisted with clean-up of the site. State personnel arranged to have the abandoned vehicle hauled away.

Fish and Game personnel also reported that our neighbor to the east may have illegally cut a row of Monterey pine trees and may be farming on refuge land. Refuge personnel located survey monuments and were able to establish that all of this activity was occurring off of Fish and Wildlife Service property.

J. OTHER ITEMS

3. Credits

This report was prepared by Dick Munoz who relied on information prepared in previous years by Louise Accurso and Ben Crabb. Typing was accomplished by Kathy Zeliff.